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**SACCHARUM :**  
(SUGAR AND SUGARCANE.)

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**CULTIVATION OF SUGARCANE IN THE BOMBAY  
PRESIDENCY.**

*by Mr. J. W. MOLLISON, Deputy Director of Agriculture, Bombay Presi-  
dency, with Descriptions of Varieties of Sugarcane by Mr. MOLLISON  
and Dr. J. W. LEATHER, Agricultural Chemist to the Government of  
India.*

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# THE AGRICULTURAL LEDGER.

1898—No. 8.

## SACCHARUM: (SUGAR AND SUGARCANE.)

[*Dictionary of Economic Products, Vol. VI., Pt. II., S. 126—40.*]

### CULTIVATION OF SUGARCANE IN THE BOMBAY PRESIDENCY.

*Notes by Mr. J. W. MOLLISON, Deputy Director of Agriculture, Bombay Presidency, with Descriptions of Varieties of Sugarcane by Mr. MOLLISON and Dr. J. W. LEATHER, Agricultural Chemist to the Government of India.*

#### CULTIVATION.

The crop is cultivated in almost all parts of the Presidency and on a greater variety of soils than any other irrigated crop. It adapts itself to almost any description of soil if drainage is secured by a pervious sub-soil or by artificial means. A water-logged condition of soil is perfectly fatal to successful cane cultivation. In other respects any description of soil of fair depth suits one or more of the many varieties cultivated throughout the Presidency.

2. The varieties may be broadly grouped into two types, but there are numerous gradations between the two extremes:

- (1) Thick, juicy, soft kinds which ordinarily require copious irrigation frequently given.
- (2) Thin, very hard, less juicy kinds which require lighter irrigation at longer intervals.

3. On the very light alluvial soils of Ahmedabad and of Bassin and elsewhere on the Thina coast and on the richer alluvial loams of the garden villages of Kaira, Baroda and Surat excellent crops of varieties of "A" type are grown. These lands are almost continuously irrigated from wells and the cane is rotated with other garden crops such as ginger, brinjal, elephant's foot (*Sorana*), yams, potatoes, sweet-potatoes, groundnuts, plantains and betel-vines.

4. In the Surat District sugarcane is not confined to soils of the above description only. It is also grown on black soil, slightly tinged with brown, about 4 feet deep, with a deep substratum of yellow earth which consists of an intimate mixture of sand, clay and lime. The sub-soil is fairly pervious to water. Cane is planted in such soil in artificially

CULTIVATION.

Soils suitable.

Different types.

General distribution of the crop in the Presidency.

Cane in Gujarat.

# **SACCHA- RUM: SUGAR.**

## **Cultivation of Sugarcane in the**

### **CULTIVATION.**

embanked fields which also grow rice, or on higher drier land; but in either case there is always an interval of several years, usually 4 to 6, between two successive cane crops. Thick soft and thin hard varieties are often grown mixed on such land. It is not clear what advantage there is in growing the two kinds mixed, except when a border of a thin hard variety on the headlands surrounds the soft succulent variety. In this case it is currently believed that less damage is done by jackals and pigs. These pests are supposed to sample the hard cane on the headlands and finding it hard or not very sweet they pass on to a field with a soft succulent variety. Very often the two types are mixed indiscriminately all over the field. The same practices are also common in the Southern Maratha Country. The Surat District has great variety of soil and considerable range in the average rainfall between Talukas. It is therefore not surprising that eight distinct varieties of cane should be found in general cultivation and at least six of these are different from any found in the Deccan or the Southern Maratha Country, and two are so distinctively coloured that they cannot be referred to any type found in other parts of the Presidency. These colours in each case can best be described as dirty.

### **Cane in Southern Maratha Country.**

5. In the Southern Maratha Country, cane is grown to a large extent on the favourably situated low-lying brown or red-brown laterite soil which also grow rice, and, where good perennial irrigation facilities exist, also grow many other garden crops. On this class of land, also on medium black soil, cane is grown at intervals of 3 to 5 years. A cane of peculiar colour is here in common cultivation. It has alternate longitudinal strips of purple and green. Similar cane is sparingly cultivated in Khambhat and in the Nira valley (Poona District), but not elsewhere in the Presidency as far as I know. In the Southern Maratha Country the general style of sugarcane cultivation is not so advanced as in some districts.

### **Cane in the neighbour- hood of Poona.**

6. The most suitable soil for cane in the neighbourhood of Poona is black or mixed black, got from decomposed trap. It is a stiff clay loam 2½ to 3½ feet deep, resting on *murum*, which is shaly limestone very permeous to water. This combination of soil and subsoil secures good natural fertility associated with good natural drainage. Only one variety of cane "Pundia" is grown near Poona. It is a particularly good variety and possibly few, if any, other varieties cultivated in other districts surpass it equal Pundia for the production of *Gul* or crude-sugar. The cultivation of Pundia is rapidly extending in other districts.

### **Period of growth.**

7. Sugarcane is commonly called a 12 months' crop. Some varieties ripen earlier than others. A crop which has been heavily manured with quick-acting manure may be forced to maturity in perhaps 11 months whilst a crop treated with a slow-acting manure may take 12 or 13 months to ripen. Again, a crop which is repeatedly top-dressed with manure continues to grow longer and probably also yields better than a crop grown with the same amount of manure applied entirely before planting. Ratoon cane ripens in less time than newly planted cane. In the best

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(James Mollison).

SACCHARUM:  
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harvest of Pooma cane planted late in March or early in April under canal irrigation is often allowed to stand over two monsoon seasons or for 18 months. Very often this practice pays, because although the cane deteriorates, the extra price that *Gal* brings (usually 50 per cent more than in the ordinary season) more than compensates for the loss. The extra charge for canal water is not much and there are no other extra expenses worth considering.

## CULTIVATION.

8. Cane is planted in different localities at different seasons. In Ahmedabad, Kaira and Baroda, it is planted in May or early in June. The soil is of sandy character. White ants are very destructive on this class of land particularly whilst the cane is young. The white ants do not do much harm during the monsoon to sugarcane, because on dry crop areas there is much vegetable growth at this season which supplies the white ants with food and the pest being widely distributed over large areas, the damage done is not particularly noticeable; therefore if the cane is sown in May it practically escapes damage whilst young. In the Surat District, also in the Southern Maratha Country, most of the cane is planted in November and December, but the season may extend to February. In the Pooma District, February and March are considered the best months to plant. The season of planting depends somewhat upon local conditions. Generally speaking any season is suitable for planting except the hot weather. Young shoots suffer considerably from the hot sun, and a check received at this time from this cause or in fact from any cause is afterwards recovered.

Seasons of  
planting.

9. The crop is propagated from sets, sometimes, as in Gujarat, by planting whole canes. The sets consist of pieces of cane generally about a foot long. Each set has usually three eye-buds, sometimes more, and the set may be 15" to 18" long. When sets are planted beds are generally previously formed. The sets may be planted at the required distance apart in pits dug out with a small pick and 3 to 4 inches deep. One set is planted in each pit. The pits are in straight rows. The sets when carefully covered with soil are 4 to 6 inches apart in the rows and the rows 2 feet distant from each other. The beds are left level. This practice is common in Baroda. Water is given immediately after planting. Sometimes three or four sets are planted together in a pit, each pit being about 6" deep and 12" to 15" square. The pits are about 2 feet apart from centre to centre. The cane then grows in clumps which stand up well in heavy wind or rain and which if bound round by dead leaves are not easily much damaged by jackals or pigs. The beds in which the clumps stand are left level. In the Southern Maratha Country it is customary, after the field is well prepared and measured, to plough it into ridges and furrows and, after watering, to trample in the sets in the furrows. When the soil dries, the harrow or light plough is used to level the ridges over the planted sets and to work the land smooth and friable, so that when the cane sends up shoots,

Propagation  
and methods  
of planting.

# **SACCHA- RUM: Sugar.**

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### **CULTIVATION.**

these may be earthed up with the plough which is worked between the rows and forms furrows which serve as water channels for temporary irrigation. Subsequently beds are formed for regular irrigation but in the case of hard varieties of cane requiring little water the surface is left level, the rows not being earthed up and the irrigation water is led over the field in the best way the cultivator can. This is not a desirable method, but when adopted in order to economize irrigation water as much as possible grass is spread over the surface and a fine layer of earth is put on the grass. This conserves moisture and therefore fewer waterings are required. In the Dhárwar District the following is a common method of planting. Cane sets are put in furrows which are made by the plough. The sets are placed 3" to 6" apart and are 12" to 15" long. Plantings are done in February. The field is immediately watered. It is not laid out in beds at all. About a handful of manure is put over each set at time of planting. When the soil dries after the first watering the ridges are split with the plough. This is done before young shoots spring up. The sets now occupy the ridges and the furrows serve as water channels for irrigating the crop and extend along the least slope, generally either in the whole length or breadth of the field.

When whole canes are planted a heavy plough is used. The canes are passed through a hole drilled in a slanting or inclined backward direction through the body of the plough and are left imbedded in the soil in the furrow and about 6 inches deep. This operation is facilitated by a man following the plough and trampling each cane into the furrow as it is pushed through the hole in the plough. The seed rate is calculated as lengths of 6 *hātis* (about 9 feet), about 2,500 six-*hātis* lengths are planted per acre. Very few single canes are each 6 *hātis* long. This method of planting is of doubtful advantage for various reasons. It is slow. The cultivators of the districts where this method is practised think it is most expeditious; but this conclusion is wrong. Many of the eye-buds are destroyed in passing the cane through the plough. Planting is commonly done in this way on black soils in the Surat District. If the plough is carefully guided the rows are moderately straight and are about 20 to 24 inches apart. After planting, the surface is smoothed and made into temporary shallow beds, and enough water is given literally to swamp the bed. As soon as the soil dries, the light plough is worked to stir the surface soil to a depth of about 3 inches. The sets are planted below this level and are not disturbed by the light plough. This light ploughing may be done twice. It kills weeds and leaves the surface soil loose and friable so that when the rows of young shoots are well up, they can be earthed up and beds can be easily formed in the ordinary way for regular irrigation. The second watering is not given for six weeks or two months after plantation and generally not more than 12 to 15 waterings are given during the year and in artificially embanked land only 9. Deep black soil is, of course, very retentive of moisture and the cane being planted

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(James Mallison.)

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SUGAR.**

Deep is favourably placed for moisture; still the practice of withholding water for a period of two months after plantation is by no means common. It is generally conceded that at least the soft-succulent varieties of sugarcane, on almost any class of land, if grown from sets, require frequent light irrigation until the young shoots are well up.

CULTIVATION.

10. There is no doubt that there is considerable advantage in planting cane deep except on very retentive soil. If planted deep, the roots get a good hold of the soil and the canes are more or less supported so that a heavy crop is not likely to be lodged by rain or wind. If planted deep in loose heavy soil germination is interfered with; at least cane will not germinate evenly if planted in this way on such land.

Deep  
planting  
advantageous.

11. The Mauritius system of planting is, I believe, advantageous on any description of moderately free working soil. In this system pits, a foot or sometimes more in depth, are dug about a yard apart in each direction. 2, 3 or 4 sets are planted in each pit and covered carefully. If the pits are deep they should not be filled up level with the surface until the young shoots appear above ground. Basins are formed for irrigation. Recently introduced Mauritius varieties do well when planted in this way, and it is probable that such Indian varieties as freely tiller would also succeed, but experimental trials are necessary.

The Mauritius  
system of  
planting.

12. In most districts of the Presidency sugarcane is rarely grown on the same land at shorter intervals than 4 to 6 years. Nowhere except in the Poona District is cane grown continuously for several years and in no other district is ratooning practised to any appreciable extent.

Cane usually  
grown at  
intervals of  
several years.

13. A ratoon crop is one grown from the root stocks of the previous crop. There is clear evidence from the experiments at Manjri that it is only in the Poona District to take more than one ratoon crop. If new cane is planted on clean land, as of course it ought to be, there is little difficulty in keeping the new cane free of weeds particularly if the crop is heavy. It is not so easy to keep the succeeding ratoon crop quite clean. In the third year it is well nigh impossible, however careful the tillage may be, to prevent *Hartia* (*Cynodon Dactylon*) and other grasses and weeds becoming more or less established. The young shoots of the second year's ratoon come up weaker than those of the first year. The root stocks of the former get overgrown to the extent that the distribution of irrigation water is interfered with. Throughout the Poona District two successive ratoon crops are generally taken. The first ratoon crop gets generally a lighter dressing of manure than new cane and the second ratoon crop gets a much lighter dressing, sometimes none at all. It is quite likely that the use of heavy dressings given to new cane and the first year's ratoon would suffice for the second ratoon crop without any direct application. Ratoon cane grown in this way would probably pay, even though a poor crop, because the cost of manure is by far the heaviest item in the cost of cultivation. On the other hand, deep-rooted grasses and other weeds

Ratoon cane.



**MAHARASHTRA-  
RUM-  
Sugar.**

### Cultivation of Sugarcane in the

**MANURE.** might get thoroughly established. The cost of cleaning and fallowing would be heavy. The profit from first ratoon is greater than from second cane. The preparatory tillage for the former is trifling. There is no expenditure for sets or for planting. Less irrigation and less manure is required.

I tabulate below outturn &c. results from first and second year's ratoon grown on comparative plots at Manjri (Poona). The plots were equally manured to secure fair comparison. Rather heavy dressings of manure were given. In ordinary practice less manure would probably have been given to the first year's ratoon and certainly to the second year's crop.

#### First year's ratoon.

Manure.	Weight of manure per acre.	Weight of cane stripped and topped per acre.	Outturn of yield per acre.	Cost of cultivation per acre.	Value of produce per acre.
Safflower and ground-nut cake ... ..	3.3	68,030 lbs.	7,680 lbs.	Rs. 20 10 0	Rs. 126 10 0
Poudrette ... ..	22'05	73,599	8,055	32 14 0	117 4 3

#### Second year's ratoon.

Safflower and ground-nut cake ... ..	3.3	38,510	4,095	202 4 0	227 5 4
Poudrette ... ..	22'05	34,530	4,040	301 14 0	221 7 4

Possibly if a much lighter dressing of manure had been given to the second year's ratoon as in ordinary practice the crop would have paid fairly well.

11. Cane is grown almost continuously under canal irrigation in the Poona District. Occasionally the land is fallowed and rested for few months, and when thoroughly clean, a green manure crop of *Sua* (*Crotalaria juncifolia*) is grown and ploughed in. This crop is everywhere recognized as a good preparation for sugarcane. A green manure crop of *Asch* (*Dolichos uniflorus*) is also considered in the Deccan a good preparation. Ground-nut before sugarcane is considered good practice if the ground-nut is well manured. The cultivation of sugarcane in the neighbourhood of Poona is perhaps typical of what it should be elsewhere, and may therefore be fully described. The best soil is a clay loam and the best preparatory crop is a green manure crop of *Sua*. The *Sua* should be sown thickly in June or July (about 70 lbs. seed per acre) and ploughed in when 3½ to 4 feet high. The crop, if thick, smothers surface weeds. It enriches the surface soil with a mass of organic matter which quickly decays and therefore leaves the soil open and friable so that subsequent tillage operations can be done quickly and well. If no green manure crop has been grown

Cultivation  
in the Poona  
District.

Bombay Presidency.

(James Mallison.)

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MANURE.

the land is allowed to lie waste during the monsoon. This is objectionable, because grasses and other weeds get established and subsequent tillage and cleaning operations are expensive. The field is deeply ploughed in November with a large eight-bullock plough, an acre being covered in about 4 days. The soil is turned up into huge clods and is allowed to weather before it is cross ploughed. One or two subsequent ploughings in December improve the tilth considerably. Most of the clods break up into smaller nodular pieces and the soil becomes easily moved to a depth of about 10 inches. I may note that I have been able to accomplish the ploughing operations for sugarcane with Ransome's Turn Wrest plough quite as effectively as with the best pattern of indigenous plough and at considerably less cost for manual and bullock power. I advocate the use of the Turn Wrest plough for sugarcane and other garden crop cultivation; but for ordinary dry-crop cultivation I cannot conscientiously urge that this plough or any other non turn-furrow plough is as good as the best indigenous implements. After thorough ploughing the surface is levelled with a log harrow and clods are broken, if necessary, by hand with a mallet or thick short stick. Then manure is applied. Poudrette or farm-yard manure are most commonly used in the Poona neighbourhood, 60 loads or 300 tons of either per acre being the usual dressing. If so much is given before plantation, the crop gets no top-dressing afterwards; but usually a smaller application of poudrette or farm-yard manure is given before plantation and the crop is top-dressed in June or July with castor cake, *le tuj cake*, fish manure or other concentrated manures.

15. It has been proved by the Mingri experiments, which will be referred to in detail further on, that certain manures are more active and effective for sugarcane than others, and that apparently the most important constituent of manures for sugarcane is nitrogen in immediately available condition. The experiments clearly indicated, if they did not absolutely prove, that nitrogen in this form was absolutely essential to feed the young shoots during the early stages of growth. The sugarcane in itself contains very little on which the young shoot can feed. Therefore in the case of land in low condition the manures to be applied before plantation should be such as are known to be quick-acting, as for instance, poudrette, fish manure and the various country-made oil cakes. Farm-yard manure, which has the reputation of acting slowly if used, should be thoroughly decayed before application. In this condition it will probably act more effectively and quickly.

16. It has yet to be proved what is the most economical dressing of nitrogen that should be given to produce the best results. DR. LEATHER has shown by analysis that even a heavy crop of sugarcane does not take up more than 100 lbs. of nitrogen per acre, yet if all the manure is applied before plantation, as it ordinarily is in common practice, at least 300 lbs. of nitrogen per acre must necessarily be given for the best results.

Nitrogen in immediately available form necessary for cane in the early stages of growth.

What is the most economical dressing of manure for cane.

# **SACCHA- RUM : Sugar.**

## **Cultivation of Sugarcane in the**

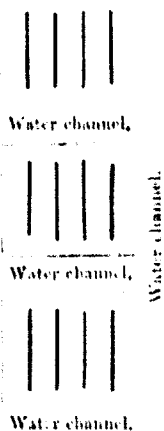
### **MANURING.**

To provide this quantity of nitrogen, probably about 30 tons per acre of ordinary cowdung and compost manure would be required. If this application contains the required quantity of nitrogen, it will certainly contain sufficient of other important elements of nutrition.

### **Top dressing recommended.**

17. There can be little doubt that the copious irrigation necessary for sugarcane washes manure away in the drainage. Dr. LEATHER has perceived by analysis that during the process of the manurial experiments at Mánjri the soil has accumulated fertility and that manures not removed by the crops are still to a large extent in the soil. There was evidence of this in 1897. The whole comparative manure area was tested for a season and on all the plots as well as on the pathways between plots a catch crop of green fodder was grown. On almost all plots the growth was very luxuriant, and the exact limits of each plot could be seen at a glance. The pathways between the plots grew in every instance only a middling crop. These pathways received practically the same tillage as the plots during the previous three years, but got no manure. The mere fact that so much nitrogen is given in the manure and so little is taken up by the crop suggests the idea that it would be far more economical to apply a smaller dressing of manure in repeated top dressings. This is practicable as regards concentrated manures like oil cakes, kelp and poudrette, &c., because of the difficulty of spreading evenly a bulky manure on a crop which has grown so that it completely shades the ground. The whole question requires thorough elucidation by experiment.

### **Method of applying manure and subsequent tillage.**



18. Poudrette or farm-yard manure should be deposited in heaps regularly over the field, three or four heaps from one end to the other. The manure should be evenly and carefully spread. The land should now be ridged up with the plough into ridges 24 or 28 inches apart, the furrows being as deep as possible. The plough should then be run across the line of ridges to form parallel water channels 10 feet apart. Finally the field should be laid out into beds 10 feet square. The *bandh* round each water compartment should be raised by soil moved with the hand hoe from the furrows and by removing about 9 inches from the ends of each ridge inside the particular water compartment. Each compartment when complete contains four short ridges and five furrows as shown in the marginal diagram. The thick lines indicate the cross of the ridges.

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**PLANTING.**

19. The planting operation proceeds very methodically. One acre of good cane provides sets sufficient for 11 or 12 acres. Ratoon cane usually provides the best sets, because the joints or nodes are close together. Usually the sets got from the top end of the cane are longer than those from the base, because the nodes of the former are farthest apart. That portion of the cane nearest the green top is considered suitable for planting. Some authorities consider the "tops" better for sets than any portion of the mature cane. There is no doubt that the tops when used as sets root quickly and the central shoot springs into growth very quickly and the germination is therefore very regular and satisfactory, but it has yet to be proved whether the resulting crop is better or worse than from ordinary sets planted in the ordinary way. Each set from the top end would be quite a foot long; whereas from ratoon cane the sets would not be more than 6 inches long on an average. 15,000 to 18,000 sets are required per acre in the Poona District. The sets are carried in head-bucks to the field to be planted and laid along the ridges and on the *beds* of each water compartment. Water is turned into each bed in turn. When the water has partially soaked into the soil and softened it, the planter begins to lay the sets carefully in the bottom of the furrows trampling each set down 3 or 4 inches into the soft mud. The distance between sets is about 4 inches. Planting in the Poona District should be done if possible in February and certainly finished before the middle of March.

20. If a concentrated manure is used, it should be applied after the beds are formed and before the sets are planted. It should be broadcast by hand along the furrows and mixed with the soil by stirring lightly with a small pick or hand hoe.

Application of concentrated manure.

21. A month after planting, the land should be carefully weeded with a *khurpa* or hand-spud. This tool is like a small sickle, both the outer and inner sides are ground or bevelled so that there are two cutting edges. The weeding should be repeated as often as is necessary. Usually four weedings are required. The *khurpa* is used not only to remove weeds but to move the surface soil. This is beneficial as the soil cracks on the surface after irrigation.

Weeding.

22. In June or July new beds are formed. The soil is dug and levelled and all weeds removed. A second dressing of manure may now be conveniently given. The canes originally planted in the furrows are earthed up with a hand hoe. This leaves a furrow between the rows of cane. These furrows serve as water-courses for water admitted into each water compartment. The earthing up gives support to the cane so that it does not readily lodge even if a very heavy crop.

Making new beds in June or July.

23. Lodging is harmful, in as much as Dr. LEATHER has proved by analyses that lodged cane contains a smaller percentage of crystallizable sugar than up-right cane. A sprinkling of *Shetti* (*Sesbania egyptiaca*) and of castors in the crop and particularly along the water channels and

Lodging of cane causes loss of sugar. How to prevent lodging.

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borders gives support to the cane so that it does not readily lodge. Moreover, the *Sheni* and castors yield good returns. Both plants grow to a height of some 15 to 20 feet in a year. The young *Sheni* branches are pruned and sold as fodder for milk goats and the trees give poles useful for roofing huts. The value of the produce from castors is also considerable. Sometimes to prevent lodging, cane is tied up. This operation must be carefully done to be effective. Cane from different roots should be tied, about six canes together loosely but securely with a band of dead leaves about 4 feet from the ground.

**Wrapping and  
wrapping.**

24. Cane is trashed by removing all dead side leaves; thus air gets freer access and no doubt the crop is benefited. Wrapping the cane in its own dry side leaves is a costly operation which, however, probably pays where jackals and rats are very destructive. Jackals will not do much harm to wrapped cane if there is unwrapped cane conveniently near.

**Irrigation  
and amount  
of water  
actually given  
for cane in  
Poona Dis-  
trict.**

25. After July or August in the Poona District cane requires no further attention except watching and careful watering. Irregular irrigation spoils the quality of the crop. It causes in soft juicy varieties splitting of the cane. The land is first flooded as the sets are planted and then after two or three times at short intervals to encourage the eyes to grow. Subsequently 8 to 10 days may elapse between waterings; the shorter interval in the hot weather, the longer in the cold season. During heavy rains irrigation is required. The rainfall in the Poona District averages about 30 inches. I have found by actual measurement the sugarcane on an average gets during 12 months, in addition to the rainfall, irrigation water equal to 75 to 80 inches of rainfall, the crop being irrigated on an average 28 times in a year. Therefore the water given at each application was equivalent to  $2\frac{1}{2}$  to 3 inches of rainfall or about 250 to 300 tons per acre. This is the quantity of water taken by an ordinary cultivator when he supplies himself from the canal. He would use less, probably to the advantage of his crop, if he drew the water from a well. We proved by actual experiment that more frequent lighter irrigation was preferable, i.e., that a considerably heavier crop was got by irrigating 34 times during the year, giving in all water equivalent to 50 inches of rainfall in addition to the rainfall (30 inches). The extent of irrigation necessarily depends upon various circumstances. The thin hard bamboo varieties require much less water than the soft thick succulent kinds. In deep moisture-holding black or clay soils the interval between waterings in the fair season may be much longer than on sandy lighter deserts. In the sandy and light loam soils of Northern Gujarat, irrigation for soft cane is necessary every 5th or 6th day in the hot weather and every 7th or 8th day in the cold weather. In central India this it may be noted that soft varieties, grown in the Surat District on embanked rice fields with deep soil retentive of moisture, if planted with a plough in moist soil in November, do not need water until the

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(Lower Malabar.)

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**Sugar.**

DISEASES.

Following February. Cane planted after November requires to be watered in January to assist germination. Six waterings are given between February and the end of May. No artificial irrigation is required in the monsoon, but two or three waterings may be given after the rains in September-October.

56. Sugarcane makes slow growth during the first three months and is quite common to grow with it subordinate crops, which ripen quickly. *Maize, Guava (Cyamopsis psoraliodora)*, cucumbers, melons and *chilies* are so grown. The maize cobs are plucked before being ripe and used as a green vegetable. The stalks are cut green and therefore give much better fodder than that from a dead ripe crop. The *guava* beans are also plucked green whilst the uprooted stalks are broken up by hand and with the leaves are left on the ground to serve as a green manure. *Chilies* are grown from transplanted seedlings raised in a separate seed-bed. They may reach maturity before the sugarcane quite shades the ground. If they do not, it does not matter as they are quite marketable at any stage of growth. Melons and cucumbers are grown from seed planted here and there, but more particularly on the headlands. These plants make very rapid growth in a heavily manured sugarcane soil. Tobacco is planted along the water courses and on the *banks* of the water compartments and takes about five months to come to maturity and the seedlings are transplanted. If the sugarcane, meantime, makes rapid progress the tobacco will not come to much.

Subordinate crops.

DISEASES OF SUGARCANE.

17. On sandy or light soil white ants are often very destructive. They attack the sets, the roots and the stems. Castor-cake used as manure is believed to keep white ants away. In Gujarat a common practice is to put a quantity of pounded castor-cake in a reservoir near a well. The irrigation water is made to flow through this reservoir. The cake gets soft and pulpy and an extract is carried by the irrigation water to the crop. In a few days the manurial value of the cake becomes exhausted and the spent cake is removed and thrown in the common manure pit. It is quite probable that this is an effective method of using castor-cake or perhaps any other cake as manure and the extract has as much effect in keeping white ants away as cake directly applied. It is questionable whether the cake becomes really exhausted by a few days steeping, yet it may be so for a somewhat analogous effect is well known by gardeners, viz., that if fresh cowdung or horse-dung is steeped in water for several days, a liquid manure is produced which is extremely scarce for roses and other plants in pots.

White ants destructive. Castor-cake as a preventive.

18. Salt is also used as a preventive for white ants. The method of application is simple. It is tied in a cloth or sack mixed with *assafetida* and hung at the head of the water channel and gradually gets dissolved in flowing water.

Salt for white ants.

**SACCHA-  
RUM:  
Sugar.**
**Cultivation of Sugarcane in the**
**DISEASES.**
**Aphides on  
sugarcane.**

29. Sugarcane is subject to several blights, known by various vernacular names, but all due to Aphides which increase rapidly especially in a cloudy weather. Their presence is always accompanied by sticky matter on the leaves. These insects feed on the juices of the plant and thus exhaust the vigour of the cane. Insecticide spray applications are the only effective remedies. An easily prepared insecticide application would consist of 2 lbs. soap boiled in one gallon of water; add 2 gallons kerosene; churn or agitate the mixture until an emulsion forms; dilute with 15 to 20 gallons of water and apply to the affected foliage with a spraying machine.

**Scale insect.**

30. A species of scale insect is common and when it exists to any extent, does considerable harm. An observant cultivator will detect the pest early. All affected leaves should be removed, and burnt, and the pest is thus at once checked.

**Sugar borer.**

31. The sugar borer, *Diatraea Saccharalis*. (vern. *Gabira*) does an immense amount of harm, and yet damage by this insect can be very easily checked, if proper measures are taken in time. The pest usually makes its appearance when the cane has fairly germinated and the first indication, in the young shoots, is the withering of the uppermost central leaves. The middle or leading shoot can be easily pulled out from its envelope of leaves, and the core of the stalk is found quite rotten with an offensive smell. A number of small white grubs are always present, and in large numbers if there is much rotteness. They are not the cause of disease, but harmless larvae of small black or brown flies, which follow the borer. The true cause of the mischief, the larva of the sugar borer, is seldom found. The round hole, by which it entered may be seen, but when there is much rotteness at the core, the borer is probably gone to another cane. If, when the first sign of withering is seen, the affected cane or shoot is cut close to the ground and slit up, one or more borers will be found in a tunnel made in the solid cane. Professor T. H. MIDGERTON, late of Baroda College, describes the sugar borer thus:—

"The full grown caterpillar is about  $\frac{1}{2}$ " long and  $\frac{1}{4}$ " diameter. The body is yellowish white with purple lines along the back. The head in the young is almost black, is brown in half-grown, and light brown in full-grown specimens. The sides of the body segments and the tail are furnished with short side bristles. Young and half-grown specimens are very active, but the old caterpillars are slow in their movements. The pupa is about  $\frac{1}{2}$ " long, is blunted and of brownish colour at the anterior end, pointed and golden yellow at the posterior. The moth emerges from the pupa after seven days. It is grey coloured,  $\frac{1}{2}$ " long with  $\frac{1}{4}$ " spread of wings. The first pair of wings is grey with fringed margins and black spots just inside the margin. The second pair is silvery. The abdomen is pearly silver grey, and extends  $\frac{1}{4}$ " beyond the wings. The moth is very sluggish in captivity and there is reason to believe that it does not move far from one locality when free."

**Remedies for  
sugar borer.**

32. Remedies.—Cut close to the ground, and burn all affected shoots as soon as withering of the central leaves is noticed. The caterpillars are almost certain to be inside the cane at this time. If no remedial treatment is adopted the insects will run through many generations in a single season, and the crop will be greatly damaged; not only so, but the canes will be so infected that they cannot be safely used for sets for re-planting. The sugarcane borer also attacks *jowar* and maize, but the moth is so sluggish

## Bombay Presidency.

(James Mollison.)

SACCHARUM:  
SUGAR.

its movements that a field cleared of the pest as described above is not likely to be re-infected by insects coming from a distance.

DISEASE.

32. Sugarcane like *jowar* and some other cereals is subject to attack by a vegetable or root parasite *Striga lutea* (*Tach* Deccan, *Apis* Gujarāt). The *Apis* of Gujarāt appears to have fleshier leaves and stems than the form of the Deccan, but they are clearly botanically very much the same and identical. The parasite is found thriving close to the stems of cane, or of *jowar*. Its fibrous roots entwine round the roots of the crops named, and check their growth. The parasite grows rapidly, and the only way to save the crop is by constant weeding. *Apis* belongs to the natural order *Scrophulariaceae*. It is found abundantly in grass *karru* (pasture lands), and therefrom doubtless finds its way to arable land in the form of animals. It survives without a host; but it can be carried in the host plant. In proof of this, I noticed one particular variety of cane, at the Surat Farm this year (1897), badly affected at an early stage of growth. Other varieties in other adjacent beds were not affected. If once established in highly manured sugarcane land, it thrives amazingly. In irrigated land it flowers and seeds at all seasons, and is, therefore, extremely difficult to eradicate.

A root  
parasite.

33. Sugarcane is subject to smut which is probably caused by the same species of *Ustilago* as causes the smut, so common in ordinary cereals. Apparently the disease only attacks the flowering rachis, and if normally confined to these parts, it cannot do much damage to the crop, as sugarcane does not commonly produce flowers. It is unusual to find varieties, which have long been grown in India producing flowers; but varieties of vigorous habit of growth, which have recently been introduced to India, generally flower freely. I have only observed smut in the thin hard or bamboo varieties, and its effect is most curious. At the Pata Farm cane propagated from sets became affected with smut when five months planted. The affected flowering stalks were premature growths. In the ordinary course no inflorescence would have been produced for 10 to 12 months after plantation. The presence of disease apparently forced the premature growth of the inflorescence in order to provide a suitable host for the disease. The source of infection was obscure; the crop from which the cane sets were got had not been observed to have been affected. Sets from this variety, as well as sets from many other varieties, all grown at Poona, were sent to the Surat Farm, and the planted at Poona. At both farms this particular variety, and no other variety became affected. It might be urged that the sets, or their eye-buds, were obviously the source of contagion. The practice of pickling cane sets, in the same way as seed grain, as a preventative is obviously inapplicable; and the only remedy appears to be to remove and burn all affected shoots.

Smut.

## HARVESTING.

34. It is difficult to judge accurately by the eye when sugarcane is ripe. Frequently a cane-grower tests the ripeness of his crop by a trial being. If so many measures of juice give a satisfactory weight of *Gul*,

Tests of  
ripeness.



# **SACCHARUM:** **SUGAR.**

## Cultivation of Sugarcane in the

### **REAPING.**

harvesting operations are proceeded with, otherwise the work is postponed for a fortnight or longer. A cane crop usually gets a yellow appearance as it ripens, but this colour may also be caused by irregular or deficient irrigation; and a crop that is in want of manure, or is otherwise badly cultivated, gets yellow long before it is ripe. In a well grown crop, if the side leaves are all dead, and if the eye-buds almost to the top of the cane are fully developed and firm, the cane is probably quite ripe. I do not think any loss is occasioned if the crop is allowed to stand for a short time after it is dead ripe, provided (a) it is not lodged, (b) that the eye-buds have not begun to freely grow, (c) that irrigation is regularly given. If the cane is watered a few days before it is harvested, the amount of sap is increased, so that more juice is expressed by the mill, and therefore more sugar obtained.

### **Method of harvesting.**

36. If it is intended to grow a ratoon crop, the cane should be cut with a sharp sickle at a height of 1 to 2 inches above ground. If a ratoon crop is to be taken, the cane should be uprooted, each cane being separately removed from the root stock by a sharp jerk. Uprooting is easily done as the roots have not a firm hold of the soil. Cane should be raised & uprooted, in the early morning whilst the leaves are yet wet with dew. Later in the day, the heads and arms of the workmen would be cut by the sharp edges of the dry leaves. A second man follows each reaper, and with a sickle strips the dry side leaves from each cane. With practice, an ordinary cooly can acquire the knack of doing this expeditiously. The upper green leaves, which are useful as fodder, are not removed in the field. The dry side leaves are left as a litter over the surface of the field. Subsequently they are collected, and tied into huge head-loads, and carried to the *Gurhil* to be used as fuel in the *Gut*-boiling process, or as thatch for huts &c. The cane is tied into bundles, and carried in head-loads to the *Gurhil*, or if the distance is far, in carts.

### **Harvesting and Gut-making done by contract.**

37. The whole operation of harvesting and *Gut*-making is undertaken in the Poona District at contract rates. The owner of the field supplies a cane-crushing mill or mills, and all *Gut*-making apparatus, and also lubricating oil. The contracting workmen find four pairs of work-cattle for each mill. The cattle are worked in relays, two pairs at a time. Eleven workmen are attached to each mill. Unless each man has an interest in the contract, more are required. They cut, and carry cane sufficient to give juice for four boilings in a working day (the work being partly done at night). Each boiling requires 22 *gharas* (earthen pots) of juice. The juice required to fill a *ghara* weighs approximately 42 lbs. One boiling of 22 *gharas* produces one *Dhep* or sugar-leaf of crude sugar (*Gut*),\* and each *Dhep* from the Poona *Pundia* variety of cane weighs from 118 to 160 lbs. according to the quality of the juice and the luxuriance of the crop. The contract rate for four *Dheps* per day is, generally, Rs. 5. Sometimes it is as low as Rs. 4. The contracting workmen get as much cane for raw eating as they like. Their women and children surreptitiously

## Bombay Presidency.

(James Mullins)

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ate or at any rate get a good deal, and every passing wandering beggar sports a good big piece of cane. The contracting workmen get the green tops to feed their cattle. Ordinarily a good many more cattle than the work cattle are actually fed. The extras, i.e. the cane for raw eating, and the green tops for cattle feeding vary in value in different seasons, therefore the contract rate also varies.

Cane-silo.

## CRUSHING.

15. The most approved pattern of mill in use in the Bombay Presidency is a three iron-roller mill made by several firms in Poona. The mill is made in various sizes. The most common pattern costs Rs. 120, and has three rollers (height of rollers 18", diameter 11") ranged vertically between upper and lower cast-iron plates. The two side rollers revolve in sockets, placed on the upper and lower plates. The upper part of each roller is cut like a cog-wheel. The cogs of the two side rollers work into those of the middle roller. The draught bar is attached to the central roller and this roller communicates the motion to the two outside rollers. The rollers are adjusted, in respect of closeness to each other, by long iron wedges, which when driven home at the upper and lower sockets, move the side rollers closer to the central roller. The shaft of the central roller passes through the upper plate. It is round in shape to a height of 6 inches above the plate. The rest of its length is square. On the upper square end of the shaft a rest for the draught pole is securely keyed. The draught pole is lotted to this rest, as shown in the subjoined diagram which shows the Poona three-roller mill at work.

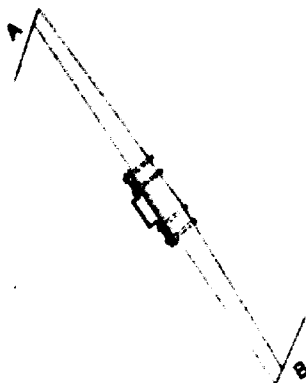
The Poona  
pattern of  
cane mill.

**SACCHA-  
RUM:  
SUGAR.**

### Cultivation of Sugarcane in the

**Cane-mill.**

The draught pole has, sometimes, at its centre an iron piece fashioned as per marginal drawing. This iron piece is keyed to the squared part of the shaft of the central roller, so that the central roller gets direct motion from the draught pole, as it is turned by a pair of bullocks, attached at A, and another pair attached at B. When the mill is adjusted for work, the rollers should be perfectly vertical, and so close together, that it is hardly possible to see through between two adjacent rollers.



**Cane crush-  
ing.**

89. The cane is passed twice through the mill, first between the middle and one outside roller and back between the middle and the other outside roller. These operations go on, simultaneously, two men, one on either side of the rollers, being required, one feeding the whole cane, the other feeding the half-crushed cane. The draught pole is fixed on the shaft high enough to pass over the heads of these men as they sit in the usual native position at work. Two men or boys drive the work-cattle, and it is the duty of one or other of these to remove the crushed refuse as it collects, a basketful at a time, and throw it down evenly in an open space to dry, so that it can subsequently be used as fuel in the boiling process. A man prepares the canes for the mill by removing the green tops and cutting long canes into two shorter lengths for more convenient handling by the man that feeds the mill. Three or four pieces of canes are passed between the rollers simultaneously. Iron mills of the above pattern can, when properly adjusted, express up to 73 per cent. of juice from soft succulent varieties of cane. The quantity of juice expressed in a working day is approximately 3,700 lbs. If the cane is soft and succulent the working day is short, but long if the cane is hard and less juicy. The edge of the lower plate is turned up about 1½" in the shape of a rim. The juice as it is expressed, collects here and flows through an opening into a receiver placed underground. This receiver holds eleven *gharas*, so that it has to be twice emptied to supply juice sufficient for one boiling. The bottom plate of the mill and the top of the underground receiver are practically flush with the ground. Close-fitting loose boards are placed over the receiver. The man who feeds the half-crushed cane sits on these boards and notices that the receiver does not overflow with juice. The juice from the underground receiver is emptied into two iron drums placed

## Bombay Presidency.

(James Mallison.)

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near the evaporating pans. It should be strained through cloth or through a wire gauze sieve to remove impurities. When these drums are quite full the juice is emptied into the evaporating pan. The two drums just hold enough (920 lbs.) juice for one boiling.

CAUTION.

40. Iron mills have taken the place of wooden mills in all parts of the Presidency. In Gujardt and in Dhárwar only a few of the cane cultivators own iron mills. The use of these will extend as the advantages become known. Their advantages, both as regards economy in labour and effectiveness at work, cannot be questioned; still the old wooden mill is very much in evidence. A common belief prevails that the wooden mill gives purer juice which can be made into finer *Gul* than the iron mill; but this is mere fancy. The true reason why the wooden mill keeps in favour is that it is made locally and the parts can be replaced or repaired as they go wrong. The mill costs Rs. 25 to 50. It is slow at work and constantly liable to accident, causing suspension of operations until the village carpenter arrives to repair it. The iron mill is an adaptation of the wooden mill. The latter has three wooden rollers about 2½ feet in length and 1 to 1½ foot in diameter. These are placed side by side in a strong wooden frame. The upper part of each cylinder is cut out in the form of a screw. The draught bar is attached to the central roller much in the same way as described for the iron mill. The middle roller is called the husband and the side rollers the wives. The male screw of the central roller fits into the female screws of the side rollers, and communicates motion to the side rollers. The cane has to be repeatedly passed between the rollers before all the juice is expressed. The mill, though clumsy and heavy to work, extracts the juice fairly well. A wooden mill in good working order extracts as much as 65 per cent. juice from soft succulent cane.

The old-fashioned wooden mill.

## GUL-MAKING.

41. The evaporating pan in most general use is about 7 feet in diameter and 9" to 12" deep. It is made of stout sheet iron which in pieces of the required shape are rivetted together. The pan has four circular handles each about 4" in diameter, welded or fixed to the lip of the pan at equal distances apart. When it is necessary to place the pan on the furnace or remove it therefrom, two stout poles are passed each through a pair of opposite handles. Four or more men lift the pan and carry it steadily by means of these poles. Two pans are required, one is used for evaporating, the other as a cooler into which the hot *Gul* is emptied when boiling is complete.

The boiling process.

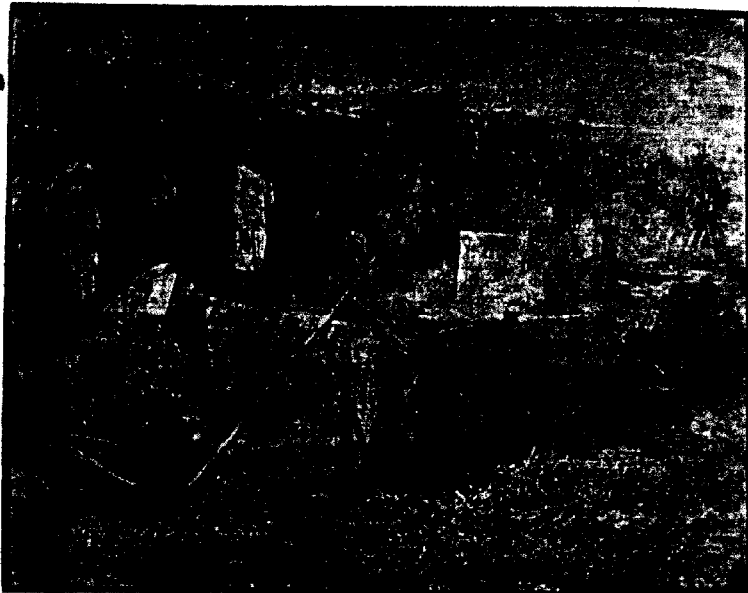
42. The oven or furnace is of simple construction. A trench is dug about 18 inches wide, 8 feet long, gradually getting deeper towards one end until a depth of some 5 feet is dug out. A circular excavation is now made at the deep end with a diameter of 4 to 5 feet. This circular chamber and the trench is the source whence the oven or furnace is provided with a draught of air and also provides room for

# **SACONIA- RUM: Sugar.**

## **Cultivation of Sugarcane in the**

### **GUL-MAKING.**

the ashes. The ashes which collect one day are removed before work begins the following day. The furnace which is partly excavated and partly built up is of larger diameter than the ash chamber. It is nearly the same diameter as the evaporating pan, being about 6 inches less, so that the evaporating pan fits neatly on the top of the furnace. The ash chamber being of smaller diameter than the furnace, a ledge is left between the two on which corrugated iron sheets are laid to form the bottom of the furnace. There is a grating in the centre about a foot square. Ashes escape through this and the draught air is admitted. The furnace is built up with sun-dried bricks in a circular form inside to a height of about 3½ or 4 feet. The brick work is banked up all round with earth. The front is built up square and a small opening is left about 20" x 14", through which the fire is fed with fuel as required. The lip of the oven is plastered smooth so that the evaporating pan fits accurately. The furnace is of large dimensions because it is necessary to maintain a regular moderate heat during the boiling process. The diagram below shows two furnaces side by side.



### **Preparing the pan.**

43. The pan is prepared before use by rubbing it well inside with leaves of the castor oil plant and then with a paste of *Udid* (*Phaseolus radiatus*) flour and *Til* (*Besamum indicum*) oil, the object being to prevent the *Gul* burning and sticking to the pan. The *aded* flour pre-

Bombay Presidency.	(James Mallison.)	SACCHARUM: SUGAR.
<p>over the oil so that the pan only requires re-coating occasionally. It is not required oftener than every two or three days.</p>		GUL-MAKING.
<p>44. The sugar boilers are professionals in the Poona District and extend that special knowledge is required to make good <i>Gul</i>. There is no mystery in the art further than that a regular heat should be maintained and that all impurities should be skimmed off during boiling.</p>		Professional boilers.
<p>45. The dry side leaves and the dry refuse of crushed cane usually provide sufficient fuel, especially so in the case of a good crop. If extra fuel is required, the husk of safflower or the stalks of <i>Tar Cajanus</i> (indians) or of cotton or light brush-wood are commonly used.</p>		Fuel.
<p>46. The fuel should be of such kind that the fire can be continuously fed by small quantities thrown into the furnace at a time.</p>		Feeding the fire.
<p>47. As soon as the juice begins to boil, impurities rise to the surface in the form of a scum. This should be removed. Skimming is done with a long-handled wicker work ladle which allows the pure juice to drain away but retains the thick scum. This ladle is also used to agitate the syrup vigorously to prevent boiling over, when the fire is too hasty.</p>		Skimming.
<p>48. The impurities are most effectively removed if a mucilaginous extract from the <i>Bāndi</i> (<i>Hibiscus esculentus</i>) plant is mixed with the juice when boiling begins or at a later stage.</p>		Impurities removed.
<p>49. It usually takes about 2½ hours to boil a panful of juice to the proper consistence. When evaporation is nearly complete, the mass acquires the yellow-brown colour of <i>Gul</i>. It heaves and bubbles rather than boils and should be kept in constant movement by a wooden hoe moved backwards and forwards in all directions. The syrup is boiled sufficiently when a little put in cold water hardens quickly. The pan is then removed from the furnace. A blessing is invoked and the contents emptied into the cooling pan. Here the <i>Gul</i> is stirred repeatedly with a wooden hoe as it cools. When it is cool enough it is put before it hardens by means of a wooden spatula into a cloth which lines a cylindrical hole in the ground. Here it sets into a hard block or <i>Dhep</i>. It is removed next day and is ready for sale. If the blocks are pale in colour and hard the <i>Gul</i> is considered of good quality.</p>		The boiling process.
<p>50. In January of this year (1898) a comparative trial was arranged for, in the Dhārwar District by the Agricultural Department, to demonstrate the capabilities of the Poona three-roller iron mill, in comparison with the time-honoured wooden mill, and with a double squeeze three-roller iron mill made at Bellary (Madras), which has recently come more or less into use in the Dhārwar District. The opportunity was also taken to demonstrate the Poona method of sugar boiling.</p>		Comparative trial with different mills.

**SACCHA-  
RUM  
EXPER.**

### Cultivation of Sugarcane in the

**COMPARA-  
TIVE TRIAL  
WITH MI-  
NIST  
MILLS.**

I believe that successful demonstrations of this kind are impressed much more forcibly and beneficially on the minds of ordinary agriculturists if conducted by native officers, provided the men so employed have tact, shrewdness, and thorough practical knowledge of the work in hand. The overseer of the stock farm and sugarcane experiments at Mánjri, who is a Kunbi or agriculturist by caste, was sent to conduct the trial. With him was also sent a professional sugar-boiler of the Poona District, also a man accustomed in the Poona District to feed fuel to the fire during the boiling process. These men could, with their own hands, build a fire-place and other necessary construction of a *Gul* mill according to the Poona plan. The work referred to, and the boiling process require a certain degree of expertness which is very easy to demonstrate by actual practice, but which would be difficult to describe by tongue or pen.

A three-roller mill and all the apparatus necessary for a complete outfit for sugar-boiling were sent to Hirekerur, Dhárwár District. The cultivation of sugarcane is very extensive in this place. The apparatus had been in use for two seasons at Mánjri, and the success of the trial may fairly be gauged by the fact that cane cultivators offered to buy the mill and all the apparatus at cost price. In consultation with the Collector, it was decided not to press for freight charges from Poona, because with the exception of the mill (the freight charges on which would be trifling) the rest of the apparatus can be locally made, now that a proper pattern is available. The freight charges on all the apparatus amounted to Rs. 70, whilst those on the mill only would be under Rs. 20.

The tabulated statements which are given below show that the Poona mill, doing 7½ of the work in a day, which it ordinarily does in the Poona District, is not only a labour-saving machine as compared with the Bellary mill and the old-fashioned wooden mill, but at work is considerably more effective. The amount of juice left unexpressed by the Bellary mill which the Poona mill could have expressed, represents a loss of one pound of *Gul* per every 100 lbs. of cane crushed, and in the case of the wooden mill 2½ lbs. of *Gul* per 100 lbs. of cane. Forty tons per acre of cane is not a heavy crop, and not more than average for the Poona District, and we may take it that the Bellary mill as worked at Hirekerur left unexpressed juice equivalent to 800 lbs. *Gul* per acre of good crop, whilst the wooden mill probably left 2,000 lbs. *Gul* per acre of good crop. The cost of the Poona mill could thus easily be recovered in a single season, owing to its more effective work. The question may be raised whether the respective mills were properly adjusted for effective work. The Poona mill certainly was, because the percentage of juice expressed is the percentage ordinarily obtained from good cane. We may assume that the cultivators had the other mills adjusted for work to the best of their knowledge. The manufacturer of the Bellary mill possibly, if he had been present, could have adjusted it better. The officer in charge

Bombay Presidency.

(James Matheson.)

**COMPARATIVE TRIALS WITH DIP-HERBERT MILLS.**

was fully instructed regarding the manner in which the trials should be conducted, and had express orders to prevent any attempts to work the cattle in any of the mills beyond their ordinary pace, whilst the trials were in progress, and generally to see that the trials were complete in every respect.

*Comparative statement showing the work of the three sugarcane mills tried at Hirekerur (Dharwar).*

Name of the Mill.	Weight of Cane.		Weight of Juice.		Weight of Gul.		Percent- age of juice Gul to Cane.		Percent- age of juice Gul to Cane.		Value of Gul pro- duced in a day.		Lam of juice in a day taking Poona mill as the stand- ard.		Value of Gul or Juice thus had per day.	
	Lbs.	lbs. oz.	Lbs.	lbs. oz.	Lbs.	lbs. oz.	Lbs.	lbs. oz.	Lbs.	lbs. oz.	Rs. s. p.	Rs. s. p.	Lbs.	lbs. oz.	Rs. s. p.	Rs. s. p.
Diurnal wooden mill with three rollers.	2,313	299 0	1,313	311 8	56 97	12 16	63 79	14 33	15 14 2	61 7 92	1 3 10	...	...	...	...	...
Diurnal iron mill with three rollers.	2,167	311 8	1,391	311 8	63 79	14 33	15 14 2	61 7 92	1 3 10	...	...	...	...	...	...	...
Poona iron mill with three rollers.	3,982	325 0	2,610	325 0	66 60	13 00	57 3 11	...	...	...	...	...	...	...	...	...

The cost of labour for each mill per day for cutting, carrying and crushing cane and sugar-boiling is shown below, also other details (labour being charged at ordinary hiring rates).

Name of the Mill.	Weight of Cane crushed.		Time occupied in crushing.	Weight of Juice obtained.		Weight of Gul obtained.	Number of boilings per day.	Labour for cutting, carrying, crushing, and boiling, &c.			Remarks.
	Lbs.	H. M.		Lbs.	lbs. oz.			Work-people.	Bullocks.	Amount.	
Diurnal wooden mill with three rollers.	2,313	9 50	1,313	311 8	3	4 men 2 boys	4	2	8 0	Man 4 annas per day. Boy 2 annas per day. Bullock 4 annas per day.	
Diurnal iron mill with three rollers.	2,167	9 21	1,391	311 8	3	5 men 1 boy	4	2	6 0		
Poona iron mill with three rollers.	3,982	8 33	2,610	325 0	3	9 men 2 boys	6	14	8 0		

The first mill is a wooden mill with three vertical rollers fixed side by side in a wooden frame, similar in construction to the mill described in paragraph 40. To work this mill one man, one lad, one boy, and four bullocks in relays two at a time, are required; the man to feed the mill,

\* Scum not removed during boiling process. † Scum removed during boiling process.

The work-people had not got experts at the work like Poona cultivators, and the work done in a day with the Poona mill at Hirekerur was about 1/3 of that usually done by contract work near Poona. Four boilings per working day are always done at Poona with animal and bullock labour equal to that used at Hirekerur, contract wages being, for bullocks and men, Rs. 8 per day.



**Cultivation of Sugarcane in the**

**CONTRIBUTOR'S NAME  
WRITE DIS-  
TINCTLY  
NAME.**

the lad to pass the cane a second time through the mill and the boy to drive the bullocks.

The following are the measurements of the different parts of the mill :—

Diameter of the middle roller	...	...	1' 6"
Do. of one side roller	...	...	1' 3"
Do. of the other side roller	...	...	1' 1"
Length of each roller	...	...	3' 6"
Length of the beam (draft pole)	...	...	8' 4"

This mill at ordinary speed makes 162 revolutions per hour.

The second mill is a three roller iron mill. Two of the rollers are of the same size, and the third is smaller in diameter. They are set vertically in a triangle. This mill is very useful for small sugarcane areas. The cane, as it passes through, is double squeezed. One man only, therefore, is required to feed the mill. A boy or lad can drive the two bullocks. Four bullocks are required for a full day's work, in relays, two at a time.

The measurements of the different parts of the mill are as under :—

Diameter of the larger roller	...	0' 8"
Do. smaller roller	...	0' 4 1/2"
Length of the roller	...	0' 10"
Do. beam (draft pole)	...	8' 0"

This mill at ordinary speed made 168 revolutions per hour.

The Poona mill described in paragraph 38 costs Rs. 120, the Bellary mill Rs. 125, and the wooden mill any price between Rs. 25 and Rs. 50, depending upon size &c.

The pan commonly used in the district has a diameter of 5' 2" at the top and is 11" deep at the centre and is saucer-shaped.

It is a common practice in the Dhárwar District to mix about 4 oz. of slaked lime to a pan of 485 lbs. of juice immediately after it is poured in for boiling. People believe that the jagri thus made is harder. The scum, although it rises during boiling, is not skimmed off, and so dark-coloured jagri is produced. When the comparative trials were commenced people visited every day in numbers, and always asked why no lime was used. They noticed the bright colour of the jagri made by the Poona method, and thought it was due to the non-admixture of lime with the juice, whereas it was really due to the removal of the scum by skimming. To prove that the reason assigned by the people was wrong about 2 oz. of lime was mixed to a pan and the jagri was in no way discoloured.\* Then the people began to say "there is much loss in throwing away the

\* If the question of discolour was the one at issue, then for fair comparison 8 oz. for a full boiling of the Poona pan ought to have been used, and that amount would probably have discoloured the jagri. Lime sufficient to nearly neutralise the acidity of the juice only should be added. If used in excess of this, Dr. Leather has proved that it does discolour the jagri. The actual effect of adding lime in proper quantity is to reduce the percentage of molasses in the Gwl and thus make it harder so that it will keep better.

## Bombay Presidency.

(James McIlisa.)

SACCHARINE  
SUGAR.

sum." An experiment was therefore made at a cultivator's *Grañdi* with the following results :—

GUL-MAKING.

Boiling.	Cane crushed.	Juice obtained.	Jagri obtained.	Percentage of Juice to Cane.	Value of Jagri per Rupan.	Value of Jagri.
	lbs.	lbs.	lbs. cu.		lbs.	Rs. a p.
Scum not removed.	729	465	104 8	14.4	16.6	6 4 3
Scum removed ...	729	465	97 8	13.3	14.2	6 18 2

The above statement shows a loss of 7 lbs. of jagri when scum was removed. But this was made good by the higher rate obtained when sold. The people were satisfied, but I am not at all sure that quality is always appreciated. In some parts of the Presidency neither the wholesale buyer nor the consumer pays much attention to quality. In parts of Gujarat no skimming is done and there, bright well prepared Poona jagri is objected to because it lacks flavour.

The only other point on which the people argued was, as regards the hardness of the respective blocks of jagri, and which would keep longest during the monsoon. The question was left in abeyance as it could not be settled, offhand, like other objections.

In Dhārwar jagri is not solidified into blocks as in Poona. As soon as the pan is ready it is removed from the fire, and stirred for a minute or so, and emptied directly into a *pack* (pit) which is made in the ground, 3 feet long, 2 feet 3 inches wide, and 4 inches deep. The pack or pit is sided with planks. The next day, the jagri in the pack has set hard, and is cut into 12 pieces each 9" square, and weighing from 5 to 7 lbs. While cutting the *pack*, there is generally about 4 or 5 lbs. of broken jagri which the owner keeps for home use. The Dhārwar cultivator shows poor ingenuity in solidifying his *Gul*. The Poona method described in paragraph 49 is much better; so also is the Madras plan of using a wooden mould divisioned into cells; but the Gujarat plan of storing in earthenware pots is best of all.

The dry leaves of sugarcane are not used for boiling jagri. They are sold for thatching. Firewood and sugarcane refuse are used for boiling.

In Dhārwar, there is not a special man to attend to the boiling as at Poona. The man that feeds the fire also looks after the boiling. The juice for one boiling weighs about 465 lbs., just about half the quantity usually boiled in the Poona boiling pan.

51. In the Poona District the *Dheps* are sold by the *Palla* of 120 or 240 lbs. By custom 246 lbs. go to the *Palla*. Generally throughout Gujarat it is customary to put *Gul* into earthenware pots. When sold a deduction of 5 *seers* per maund or 12½ per cent. is allowed

Marketing  
gul.

**MAJORANA-  
SUM:  
Sugar.**

**Maximum  
Excess-  
Kure.**

### Cultivation of Sugarcane in the

on account of the pots; but usually the actual weight of pots exceeds this allowance. There is a decided advantage in storing *Gul* in this manner, because if soft there will be no loss of treacle by drainage. Moreover, the *Gul* can easily be protected from flies and other insects. When sold by retail one side of the pot is broken off and the *Gul* is easily removed in small quantities. In Khândesh the potters who provide the earthen pots claim the crushed cane (megass) as their perquisite. They extract by lixiviation a small amount of inferior *Gul* and use the residue for burning pots and bricks.

### COMPARATIVE MANURING EXPERIMENTS AT THE MÂNJRI EXPERIMENTAL STATION NEAR POONA.

**Results of  
two years'  
experiments  
recorded.**

52. These experiments were begun in 1894-95, but the plots were not manured in that year in accordance with any definite standard and were, therefore, unequally manured. Moreover, after a year's experience it was found expedient to modify the original scheme considerably. The results which I shall record are those of 1895-96 and of 1896-97. The former crop was newly planted cane, the latter was a ratoon crop grown from the root stocks of the previous crop.

53. *Objects of the experiments.*—To test the comparative value of such manures as are within the reach and means of ordinary cultivation, and when the effects of the various manures have been clearly demonstrated then to determine whether two or more of the manures used cannot be judiciously combined so as to secure economy.

In both years the various manures each contained 500 lbs. per acre of nitrogen. The percentages of other elements of value are known, and in years to come it may be found that marked differences between the crops of the various plots may be traced to the value of elements other than nitrogen. If this can be done the value of the experiments will be enhanced and information be gained which will indicate how two or more manures should be mixed to give the most paying results.

**Several edible  
oil-cakes  
tested as  
manures in  
comparison  
with those  
ordinarily  
used.**

54. The manures which the cultivators of the Poona District ordinarily use are poudrette, cattle-dung, fish manure from the Thina coast, castor-cake and *Karanj* (*Pongamia glabra*) cake. In both years we have tested and will continue to test in comparison with the foregoing several edible cakes which are now used for feeding cattle in India or are largely exported. These cakes can be bought in Poona at a considerably cheaper rate per ton than the castor and *Karanj* cake now so extensively employed as manure. Dr. LEATHER'S analysis shows that the edible cakes contain much higher percentages of nitrogen (the most valuable constituent of manures) than the manure cakes, and our tests indicate that these edible cakes can be employed with economy and success as manure. It has been suggested that the use of edible cake as manure is surely a wasteful practice. My answer to that is that it is surely a much more wasteful practice to feed milch and work cattle with cake and other concentrated food and permit the solid excrement to be burnt as fuel and the

## Bombay Presidency.

(James Mollison.)

BACONHA-  
RUMI  
Sugar.MANURE  
EXPERI-  
MENTS.

not to be lost. If edible cake is used directly as manure, something is returned to the land which will help to maintain fertility. It might be argued that work and other cattle can only be kept in efficient condition if partially fed on cake or other concentrated food and, therefore, it becomes necessary to show that the increased production of cane through the use of edible cakes as manure more than compensates for the cost of substituting food given to cattle. This is difficult to show in black and white. At the same time, the fact that an application of 3 tons per acre of edible cake is capable of producing as much as 12,000 lbs. of crude sugar per acre as food for men and 12,000 to 15,000 lbs. of green tops fodder for cattle proves that edible cake is put to a good use when used as manure. I admit it would be put to a better use if fed to cattle and the solid and liquid excrements are properly conserved and used as manure.

55. There is no definite relationship between the values of the manures as determined by chemical analyses and their commercial value. It is certain that the cane-growers of the Poona District, though much above the average in intelligence, fail to recognise the difference in the actual value of the manures they use.

56. The results of our comparative manure experiments are not only intended to prove which manures in given quantity are most effective for sugarcane, but also which manures are cheapest. It may be said when a particular manure is shown to be cheap its extended use will soon make it dear, but there will be an advantage to somebody.

57. Farm-yard manure and cattle-dung are charged at full local rates, but it is right to notice that these rates are four times as high as cattle-dung sells for in out-districts where irrigated crops are not grown. It will probably be found eventually that at out-district rates, cattle-dung will be proved much the most economical manure that a cultivator can use; because considering its chemical composition it is much the cheapest. The value for manure will vary with the food given to the cattle and the care with which it is preserved with litter and urine. Properly saved farm-yard manure will not, as our experiments indicate, be weight for weight as valuable as pure dung, but then the manure pit will be filled much more quickly with the former than the latter. The dung from poorly nourished animals is considered by ordinary cultivators to be as good as that from those highly fed. Both descriptions are with equal readiness used as fuel. In almost all districts the value of cow-dung as fuel is as great or greater than its value as manure because wood is scarce and dear. In the Poona District this is notoriously the case. Therefore it is not surprising that a cultivator of cane sells the dung of his cattle as fuel and buys poudrette, oil-cake, &c., for his crop.

58. Although the quantity of each manure applied in the Comparative Manure Series contained 500 lbs. of nitrogen, there were very marked differences in outturn between the various plots. This was particularly noticeable on the new cane, not to such an extent with ratoon.

No definite relationship between the commercial value of manures and their value according to chemical analysis.

Farm-yard manure probably the cheapest manure a cultivator can use.

Quick-acting manures give the best results especially in the case of new cane.

# **SACCHA- RUM: Sugar.**

## **Cultivation of Sugarcane in the**

### **MANURING EXPERI- MENTS.**

Ratoon cane owing to its greater root development is able to get nutriment from a slow-acting manure much more effectively than new cane does in the early stages of growth. At any rate the differences between the plots of new cane were, in a great measure, due to variation in the activity and effectiveness of the various manures. Ratoon cane springs up active and vigorous growth at once and at the early stage there was no appreciable difference between its various plots; but in the case of new cane it was clear that some of the manures acted far more actively than others. How far the action was due to the presence in the manure of elements other than nitrogen, can only be conjectured at this stage of the experiments. The practical fact remains that certain manures, fish manure, poudrette and some oil-cakes had quicker action than other oil-cakes and much quicker action than cowdung or farm-yard manure.

Slow-acting manures caused uneven germination.

Oil-cakes made in country *ghāni* extremely quick-acting.

Hydraulic pressed cake slow in action for reasons given.

Period of growth.

Manures applied partly before plantation, partly as a top dressing.

59. On plots with slow-acting manures, germination was irregular and the young shoots which did grow were obviously starved and checked in growth. This check was never afterwards recovered.

60. Oil-cakes as made in Europe are generally considered to be slow in their action as manure. Oil-cakes as made in the ordinary country *ghāni* are extremely quick in their action. In India oil-seed is ordinarily pressed is ground up into an impalpable powder as the oil is expressed. The oil-cake is consolidated during the process, but when it is applied as manure it is again powdered, and I have no doubt that minute particles of cake again disintegrate into impalpable powder when brought into contact with the moisture of the soil. It is easy to understand that a manure in such a fine state of division will very soon show its effects upon a crop. The method of preparing cake in Europe and the hydraulic press mills in Bombay is quite different. The seed is crushed, but not into fine particles. The crushed seed is cooked and steamed. Thus the oil freely escapes from the oil cells. The cooking of the crushed seed would of necessity convert the albuminoids into a much more insoluble condition than that in which they exist naturally. The albuminoids contain nearly all the nitrogen of the seed, and it is reasonable to suppose that the nitrogen as it exists in hydraulic pressed oil-cake does not become available as plant food nearly so soon as that in oil-cake made in the ordinary country *ghāni*.

61. The results of the comparative manure experiments which tabulate below under Series A and Series B will be better understood from the above explanations.

62. The new cane was cut in 11½ to 12 months after plantation. Those plots which germinated well and were dressed with quick-acting manure ripened soonest. The ratoon cane was cut 10 to 10½ months after the previous crop was reaped.

63. In 1895-96, the manure was applied three-fifths before plantation in March and two-fifths in July. In 1896-97, the ratoon plot were manured with three-fifths of the application in May and two-fifths in July. It is not customary to give manure to a ratoon crop and it has made considerable growth.

Bombay Presidency.

(James Mallick.)

**SACCHA-  
HUM:  
Sugar.**

**MANURIO  
EXPERI-  
MENTS.**

Comparative Manures, Series A, 1896-97 and 1897-98.

Name.	Year of Crop.	Manure per Acre.	Nitrogen per Acre		Cost of Manure per Acre		Weight of cane stripped and top-weighted per Acre.	Weight of Tops per Acre.	Weight of cane per Acre.	Percentage of cane to cane.	Remarks.
			Tons.	Lbs.	Rs.	P.	Lbs.	Lbs.	Lbs.	Lbs.	
Sachha-hum cane.	1896-97	33	200	100	6	55,500	12,500	12,500	12,500	12,500	Planted 1st April 1896, harvested 23rd to 27th March 1897. Germination very regular. Crop had throughout an extremely healthy appearance, the leaves until the crop ripened being of a rich dark green colour. Irrigated 27 times.
	1896-97	33	500	150	11	11,700			8,100	11,700	Harvested 15th, 16th January 1897. Crop looked vigorous and healthy throughout. Irrigated 16 times.
	1896-98	33	500	150	11	11,700			8,100	11,700	The first application of Saccha-hum had apparently a poisonous effect. Only a set here and there germinated, replanted and then germination was quite satisfactory. The top dressing of manure given in July showed beneficial results. The crop from the second planting made steady vigorous progress. It was not fully ripe when harvested. It left sugar, the results of the next crop would be interfered with. Planted on 1st April 1898, replanted on 21st May 1898, harvested 2nd, 3rd, 4th March 1899. Irrigated 27 times. The low percentage of cane to cane indicates that the crop was not fully ripe.
Sachha-hum cane.	1896-97	53	500	200	7	55,500			7,800	11,700	Harvested 15th January 1897, regular germination. Healthy growth throughout. Irrigated 16 times.
	1896-98	71	500	316	6	55,500	14,000	10,700	12,500	12,500	The cane was put from a Bombay mill, which, however, has stopped the manufacture, because the percentage of oil got from Indian seed is small and does not pay. The crop had a very thriving appearance throughout. Planted 31st March 1896, harvested 28th to 31st March 1896. Irrigated 27 times.
	Crushed cotton-seed	56	500	381	1	13,645			9,500	12,500	Crushed cotton-seed was substituted for cotton seed cake, the latter not being obtainable. It is believed that in districts where cotton is grown, and where the seed is very cheap, it will probably be found an economical manure for sugarcane grown in the same districts. The dark-green colour of the leaves of the cane was conspicuous in comparison with some of the other plots of the series. Reaped 12th, 13th January 1897, Irrigated 16 times. The price paid for the cotton seed is much dearer in Poona than in cotton-growing districts.

**MAHARAJA  
POH:  
SUGAR.**
**Cultivation of Sugarcane in the**

MANURING EXPERI- MENTS.	Plot Number.	Manure.	Years of Crop.	Manure per Acre.	Nitrogen per Acre.		Cost of Manure per Acre.		Weight of Cane stripped and top- ped per Acre.	Weight of Tops per Acre.		Weight of Cane per Acre.	Percentage of Cane to Cane.	Remarks.
					Tons.		Rs. a.			lbs. + lbs.				
					Tons.	lbs.	Rs. a.	Rs. a.		lbs.	lbs.	lbs.		
7	Fish ma- nure.	1895-96 New cane.	2-9	500	124	12	95	87	11,115	11,900	13-2	The evenness of germination and vigour of growth were more con- spicuous than in Plot 1. The manure must be ploughed in a dug in deeply, otherwise the jackals, dogs and pigs are attracted. Crop planted on March 1896, reaped 1897 on 17th March 1898. Irrigated 2 times. The high percentage of Cane to cane is due to Reaped 17th and 18th January 1897. Irrigated 17 times.		
		1896-97. Balloon cane.	2-7	500	104	7	76,948	...	9,000	11-7	Germination and flowering were satisfactory, but the crop was not the thriving, vigorous ap- pearance and healthy growth of the best plots in the series. Planted 24th March 1896, har- vested 15th and 16th March 1897. Irrigated 20 times.			
		1895-96 New cane.	2-9	500	203	10	80,771	12,015	9,920	12-1	This plot gave the best crop in a whole series. Harvested on and 12th January 1897. Reaped 17 times.			
8	Castor cake.	1895-96 Balloon cane.	2-2	500	212	11	70,948	...	8,790	12-3	Very little difference in the ap- pearance of this and the adjoining castor-cake plot. Planted 31st March 1896, harvested 17th and 18th March 1897. Irrigated 20 times.			
		1895-96 New cane.	2-2	500	203	7	70,000	...	8,415	12-0	Reaped 18th and 19th January 1897. Irrigated 16 times.			
		1895-96 New cane.	22-3	500	150	8	80,720	11,455	10,455	12-9	Results conspicuously good as compared with some other manures. Our results and the chemical analysis indicate that the manure is a cheap, if not the cheapest, source of nitrogen in India even at the present price which is very high. The manure only obtainable at pe- culiar centres, mostly in the port. Crop planted on Mar- 1896, harvested 18th and 19th March 1897. Irrigated 3 times.			
12	Poudrette.	1895-96. Balloon cane.	20-1	500	179	13	55,435	...	7,410	13-4	The crop was somewhat dis- appointing. Germination was satisfactory, but the crop is at a stage of growth had the thin appearance of the previous year's crop. Harvested on 9th January 1897. Irrigated 7 times.			
		1895-96. New cane.	25-1	500	100	0	60,400	12,230	7,210	12-4	The results compared with the other plots are poor. Some dressing of the same manure was given in the previous year to this plot also with per- sonal. The difference in the cane dung is also in its action. The germination was quick and regular, but the crop had the ap- pearance of a yellowish, unhealthy appearance. Planted on 12th March 1896, harvested 18th and 19th March 1897. Irrigated 5 times.			

Bombay Presidency.

(James Mollison.)

**SACCHARUM:**  
**SUGAR.**

**MANURING**  
**EXPERI-**  
**MENTS.**

Manure.	Year of Crop.	Manure per Acre.		Cost of Manure per Acre.		Weight of Cane stripped and top per Acre.	Weight of Tops per Acre.	Weight of Gail per Acre.	Percentage of Gail to Cane.	REMARKS.
		Tons.	Hrs.	Rs. s.	lbs.	lbs.	lbs.	lbs.	lbs.	
Cattle dung from well-sown cane.	1896-97. Ratoon cane.	10-0	500	137 12	70,145			8,150	11-6	This plot gave much more satisfactory results under ratoon, cane than in the previous year. Owing to the well-known lasting effect of cattle dung the crop probably benefited by the unexhausted residue of the same manure applied during the two previous years. Harvested 24th and 26th January 1897. Irrigated 15 times.
	1896-97. N e w cane.	25-0	500	184 14	55,720	11,175	6,050	12-0		The remarks made against Plot 18 apply equally to this plot. Crop planted 30th March 1895, harvested 24th to 26th March 1896. Irrigated 27 times.
	1896-97. Ratoon cane.	25-00	500	142 12	62,206			7,770	12-0	Ratoon crop more satisfactory than the previous year's crop of new cane. It is, however, clear that there are more satisfactory manures for sugarcane than either farmyard manure or cattle dung. Crop harvested 24th January 1897. Irrigated 16 times.
	1896-97. N e w cane.	3-4	400	162 0	2,440	10,000	7,000	12-4		The cake used is a hydraulic pressed cake made in Bombay from coarsely ground steamed seed. For this reason the cake possibly acts slowly. The results are poor for a cake so rich in nitrogen, and compare unfavourably with the other oil cakes, which, however, were all made in the country and, therefore, probably acted more quickly. Planted 30th March 1895, harvested 1st to 23rd March 1896. Irrigated 27 times.
Bullion or pressed cake.	1896-97. Ratoon cane.	3-0	500	158 13	68,050			7,450	11-3	The crop looked fairly promising during the whole period of growth, but the outturn of Gail is rather disappointing. It may clearly be inferred that hydraulic pressed cake made from coarsely ground steamed seed is slow in action even though rich in nitrogen. Harvested 18th and 19th January 1897. Irrigated 16 times.

Comparative Manures, Series B, 1895-96 and 1896-97.

40 lbs. meal.	1895-96. N e w cane.	110	120	116 0	22,145	8,475	3,905	12-1		A heavy application of bones (6 lbs. per acre) was given to this plot in the previous year with poor results. It might reasonably have been expected that the residue left would have benefited the crop of this year. There is nothing to indicate that such is the case. The action of bones is so slow that they cannot be economically used as manure for sugarcane. The crop had the appearance of being starved throughout its growth. Planted 1st April 1895; reaped 25th to 27th March 1896. Irrigated 27 times.
	1896-97. Ratoon cane.	2,343	130	122 11	30,900			3,165	11-9	The results this year with ratoon confirm the above remarks. Reaped 14th January 1897. Irrigated 16 times.



HAWAIIAN  
SUGAR  
SUGAR.MANURING  
EXPERI-  
MENTS.

## Cultivation of Sugarcane in the

Plot Number	Manure.	Year of Crop.	Manure per Acre.	Cost of Manure per Acre.		Weight of tops stripped and top- ped per Acre.	Weight of Tops per Acre.	Weight of Cane per Acre.	Percentage of Cane to Cane.	Remarks.
				lbs.	No. a.	lbs.	lbs.	lbs.		
5	Dissolved bones.	1896-98. New cane.	2,550 Bones dissolved in acid.	130	196 0	24,275	6,585	4,850	15.6	Matured with 6 tons per acre dissolved bones in previous year. Crop fair, but cost of work, heavy dressing of manure actively prohibitive. This manure made on farm less of ordinary commercial strength used; 640 lbs. acid to 1,550 in bone meal. The price of the manure is entirely prohibitive for ordinary cultivation in the Poona district. Planted on April 1903, harvested 27th and 28th March 1904. Irrigated 2 times.
		1896-97. Ratoon cane.	4,401 dissolved bones or 3,513 crushed bones dissolved in acid.	130	207 5	31,948	...	6,368	11.6	Better results but not good enough to pay considering the expense dressing of manure. Reaped 19th and 24th January 1907. Irrigated 16 times.
		1901-02. New cane.	3,500 bone meal 1,000 nitre.	280	264 0	11,000	10,077	8,018	12.3	One-fifth of the nitre was applied before plantation; the rest in four equal top dressings given in June, August, October and December. It was believed to be economical to apply the nitre in top-dressings, because being very soluble it is easily washed away in drainage if not taken up by the crop almost at once. The crop did not benefit to the extent that was expected and the cost of the manure exceeds the value of the crop. Planted 20th March 1903, harvested 20th and 21st March 1904. Irrigated 27 times.
10	Bone meal and crude nitre.	1896-97. New cane.	3,843 bone meal 1,230 nitre.	230	235 0	30,380	...	4,800	9.7	Nitre applied in 5 top dressings at intervals as above. The crop only yielded 53 7 per cent. per acre whereas the average of all other manure plots was approximately 86 per cent. The percentage of Cane to cane is very low. It can offer no satisfactory explanation. Again, the cost of the manure about equals the value of the crop. Reaped 24th and 10th January 1907. Irrigated 15 times.
		1896-98. New cane.	3,430 bone meal dissolved and 1,730 nitre.	250	244 0	63,713	11,093	8,433	12.4	Nitre applied as in Plot 10 for similar reasons. It is clear that dissolving the bones makes the manure more effective but the cost is entirely prohibitive. Crop planted 21st March 1903, reaped 20th to 21st March 1904. Irrigated 27 times.
		1896-97. Ratoon cane.	3,513 bone meal dissolved or 4,401 dissolved bones and 1,230 nitre.	230	244 0	63,905	...	7,845	12.7	Nitre applied as above. Crop reaped 24th and 24th January 1907. Irrigated 15 times.

Bombay Presidency.

(James Mallison.)

**SACCHA-  
RUM;  
Sugar.**

64. The estimated cost per acre of cultivating sugarcane by hired labour in the Poona District is as follows:—

First ploughing in November; 4 team plough does an acre in 4 days; 1 plough- man and 2 boys or lads driving	Rs. a.
Second and 3rd ploughing in December	16 0
Leveling with log harrow twice and breaking clods by hand implement	12 0
Manure; cartage and spreading 25 tons poundrette per acre	3 0
Edging; ridges 24" apart; 3 team plough, 1 ploughman, 1 driver; 1 acre per day	180 0
Making water compartments; contract-rate	2 8
Value of sets, 18,000 per acre	2 4
Carrying sets to field; 1st watering and planting	50 0
Watering 32 times in a year; 1 man for five acres at Rs. 7½ per month	5 0
Hand weeding; first weeding a month after planting and other three at intervals as required until June	18 0
Digging and making new beds in July	12 0
Water-rate (canal water)	10 0
Cost of constructing gurdā; Rs. 10 or Rs. 2 per acre	40 0
Hire of sugarcane mill and other apparatus; Rs. 1 per day or Rs. 16 per acre	2 0
Harvesting and Gāl-making at contract-rate of Rs. 5 per 600 lbs., say	16 0
Marketing Gāl and commission to Daldā as at Poona, Crop, 40 Pallas of 240 lbs. per acre	25 0
	39 0

**CHEMISTRY  
OF  
SUGARCANE.**  
Cost of culti-  
vation.

Value of crop; 40 Pallas at Rs. 14 per Palla (price varies in any season from  
Rs. 12 to 18) ... 560 0

65. In growing a ratoon crop the cost of preparatory tillage is trifling. No sets are required; less manure is required than for new cane. The crop requires less irrigation than new cane, and altogether the saving is the cost of cultivation as compared with new cane is Rs. 120 to Rs. 150 per acre. A ratoon crop which has thriven well yields as much Gāl per acre as a fairly good crop of new cane. In paragraph 18, I have shown the actual cost of cultivation in an experimental plot at Mánjri at Rs. 325 per acre and value of produce at Rs. 447.

66. DR. LEATHER'S investigations into the chemistry of the sugarcane crop have been published in full detail in the *Agricultural Ledger* (*Medical and Chemical Series Nos. 1, 4, and 9*). The following is a succinct résumé of the work as published in paragraphs 114 to 128 of DR. LEATHER'S Final Report:—

*Conf. Agricul-  
tural Ledger  
Nos. 13 &  
1805, 19 &  
1806, and 1  
of 1897.*

\* 114. The investigations may now be conveniently referred to under the following heads:

- (1) The composition of the juice—(a) in cane which had been transferred to long distances; (b) in cane which had been grown with varying amounts of manure; (c) in cane which had become lodged; (d) in the top ends of the cane; (e) in different varieties of cane.
- (2) The relation between the amount of sugar in juice and its specific gravity.
- (3) The determination of the amount of inversion which takes place during the concentration of the juice.
- (4) The amount of sugar which becomes lost in the scum.
- (5) The composition of the raw sugar, gur, gāl, and rib.
- (6) The refining of sugar by means of the hand centrifugal separator.

# **SACCHA- RUM: SUGAR.**

## **CULTIVATION OF SUGARCANE.**

### **Cultivation of Sugarcane in the**

- (7) The total amount of sugar in cane and the amount remaining in the crushed cane.
- (8) The amount of phosphoric acid and nitrogen in the sugarcane crop.

"115. (1-a).—*The composition of the juice of cane which had been transferred to long distances.*—In the course of the experiments under reference, several varieties of cane have been transported to considerable distances. In 1894, two varieties were sent from the Mauritius to Poona, one a white and the other a red variety. They were grown at Poona with very liberal amounts of manure, and so far as appearances went, both crops were splendid. They were reputed to give a juice containing some 18 per cent. of sugar. But at Poona the juice of both has contained much less than this amount. In 1895, the juice of the white variety contained about 12 per cent. of cane-sugar and 1·4 of glucose; that of the red variety about 10 per cent. cane-sugar and 2 of glucose. In 1897, (the third crop) the corresponding figures were 14·71 per cent. cane-sugar and 0·99 of glucose in the juice of the white and 12·7 of cane-sugar and 1·5 of glucose in that of the red variety. Thus, although the juice is still poorer than it ought to be, a material improvement has manifested itself during the three years.

"A second example of this nature occurred in the case of the Poona *Pandia*, the variety commonly grown around Poona. This cane at Poona has been found to contain from 14 to 15 per cent. of total sugar. It was sent to Cawnpore and Durnoon in 1895, but the crops at both farms produced a juice containing only 16 per cent. of total sugar in the 1895-96 crop, and there was just about the same amount in the crop of 1896-97.

"Some further evidence was gained during the past season. A number of varieties, commonly grown in the Bombay Presidency, were collected in 1896 and grown at Poona in 1896. These crops were then analysed in the past cold weather. Immediately afterwards I visited villages in the neighbourhood of Helgaum and Dhárwár, and analysed some of these same varieties in their native place, and it was then found that in three cases the quality of the juice was much lower, in two instances it was higher, and in one it was the same as at Poona in the crops at Helgaum and Dhárwár. Thus the evidence at hand points to the conclusion that transference of cane from one country to another may cause a material alteration in the development of the plant generally resulting in depreciation of the juice. The evidence given by the Mauritius varieties, however, indicates that the cane will gradually assume a normal composition in the course of a few years."

"116. (1-b).—*The composition of the juice of cane which has been grown with varying amounts of manure.*—One of the questions which naturally presented itself at the commencement of the experiments was, 'What effect has manuring on the quality of the juice of sugarcane?' The plots at Poona and at Cawnpore received in each case very varying amounts of manure, and the question appeared to be one which would be readily solved. Accordingly, one or more samples of the juice of the cane from each of the plots in question at these two farms was analysed during the harvest. The results at first obtained are quite uniform.

"The cane at Poona (*Pandia*) was grown with a series of different manures, varying very much in amount, the nitrogen from 130 to 1,040 lbs. per acre, and the phosphoric acid from 140 to 2,700 lbs. per acre; in all cases the amount of manure was large. The percentage of both cane sugar and glucose was found to be very constant in each year, namely, from 15 to 17 per cent. of cane-sugar and 1·0 to 1·3 per cent. of glucose.

"At Cawnpore a small cane, the *Mutan*, was grown in 1891-93 and 1895-93, with different descriptions of manure, in varying amount (the nitrogen varied from nothing on the unmanured plot to nearly 200 lbs. on the most heavily manured plot); the weight of manure being in all cases very much smaller than was the case at Poona. Again, the analysis of the juice of this cane showed no relation between the amount of manure applied and the quality of the juice: the cane-sugar varied from 14 to 17 per cent. the first year and from 15 to 17 per cent. the second year, and the glucose from ·3 to ·5 per cent. Thirdly, at

\* This is confirmed by the remarkable manner in which the Southern Mauritius varieties are used to their normal standard in the second year of cultivation at the Poona Farm, although they had deteriorated considerably in the first year's cultivation. See description of Bombay varieties page 51 to 57.—J. W.

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Cawnpore in 1896-97 another variety was grown, a thick *Pandua* called *Madras*, and this was manured with different materials containing from 230 to 500 lbs. nitrogen per acre, the amounts being in every case large. The percentage of cane-sugar varied from 14 to 16.5 per cent. and the glucose from 0.5 to 0.9 per cent.

\* Thus the evidence adduced from three somewhat extensive series of tests pointed uniformly to the conclusion that neither the kind of manure, nor its amount, exercised any influence on the quality of the juice of sugarcane.

\* It so happened, however, that conflicting evidence was met with during the cold weather of 1896-97 at Cawnpore. Six varieties, three thin ones and three thick ones, have been grown at this farm for three years. One of these was the *Matua* variety already alluded to. In 1896, it was decided to grow this variety (along with the others) with large amounts of manure. It now grew much taller than usual, and the weight of crop was much increased. When, however, the juice came to be analysed, it was found that, instead of containing the 15 to 17 per cent. of cane-sugar which had been maintained for two years, the proportion had fallen to 11 per cent.; on the other hand, the proportion of juice expressible by the mill, which had previously been 45 to 50 per cent., was now found to be 60 per cent.

\* Another piece of similar evidence was obtained in connection with the Dumraon experiments, where it is probable that high manuring had, in the case of certain canes, reduced the proportion of sugar. But a consideration of the evidence on this subject clearly offers an explanation of the effects noticed.

\* It is certain that under the conditions of growth of the Poona *Pandua*, the *Matua*, in 1894-95 and 1895-96, and the *Madras* in 1896-97, manuring had no material effect; and these conditions are readily set out. The Poona cane is commonly grown with large amounts of manure, and it was similarly supplied in the experiments. The *Matua* is commonly grown with only small amounts of manure, and only small amounts were supplied to it at Cawnpore in the first two years. Thirdly, the *Madras* variety is commonly heavily manured, and the treatment for it was similar in this respect at Cawnpore in 1896-97. Thus, while the conditions of manuring assimilated to those to which the several varieties are accustomed, the proportion of sugar remained normal, whereas, if the one or two cases of sudden change in the composition of the juice due to heavy manuring are to be relied on, it would appear that a variety may produce a poor juice, if it be suddenly grown with much larger amounts of manure than those to which it has been accustomed for long periods.

\* It must not be supposed, however, that a less outturn of sugar was realized in the case of *Matua*. Although the percentage of sugar in the juice was less, much more juice was obtained, and the crop was about twice as heavy. So that from the economic point of view there was a considerable gain. Moreover, the evidence, such as it is, of the varieties at Dumraon, point to the fact that under the new conditions the varieties will regain their normal growth in the course of a few years. The case is indeed very similar to that referred to in paragraph 115, where the effect of change of climate is discussed, and it seems likely that a cane may suffer from either cause; the effects are however probably only temporary.

\* 117. (1-a).—*The composition of the juice of cane which had become lodged.*—The crop of cane at Cawnpore was much lodged in 1894 by rain, and it was decided to crush the fallen cane separately from that which remained erect. It was then found that the juice of the lodged cane contained much less sugar than that in the standing cane, and the juice prepared from it was so full of molasses that it would not solidify. In the other two years the weather was not abnormally wet, and no further evidence of the effects of heavy rain has been obtained; but the crops at Cawnpore and Dumraon were so heavy in 1896 that some parts fell down. The juice of the fallen cane was again separately examined, with the result that it was found to contain generally a less proportion of cane-sugar, and a larger one of glucose, than was found in the standing cane. The differences were on the whole not great, and nothing like so serious as was the case with the crop which had been lodged by rain in 1894.

\* 118. (1-a).—*The composition of the juice of the top ends of the cane.*—My attention was directed to the quality of the juice in the top ends of the cane, because in the Burdwan District of Bengal it is customary to propagate the crop from the top ends only, whilst in most parts of India the usual practice consists in cutting up whole cane into pieces and propagating from them.

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"Moreover, it so happens that in no part of India is the cultivation of cane, in most respects, more perfectly carried out than at Burdwan, and one at least of the varieties there grown, is an exceptionally good one containing from 16 to 18 per cent. of sugar. In respect, therefore, could it be said that the quality of the cane or the cultivation was inferior. Now the weight of cane which is used for sowing is very considerable, amounting to several thousand pounds per acre, and the question naturally presented itself, what sort of juice is contained in the top end of the cane, and is it an economy in the matter of sugar to propagate from the top ends only? Accordingly, several sample bundles of cane were taken at Burdwan this year, the top ends cut off, and the juice expressed and analysed from the top ends and the remaining cane, respectively. The experiment showed quite conclusively that there was much less juice in the top ends than in the main part of the stem, and much less sugar in that juice. Consequently it is apparent that, if an acre be sown with the top ends of the cane, and the main part of the cane be reserved for sugar-making, an economy in sugar will result. Taking the figures which were obtained in the experiment as a basis of calculation, this economy amounted to about 320 lbs. of raw sugar in the case of one variety, and to about half that amount in the case of another; or we may say that by propagating from the tops only, a saving of several hundred pounds of raw sugar per acre will be realised.

"It appeared desirable that other varieties should be propagated from the top ends only, in order to determine whether any deterioration of quality resulted, and this is being done at Cawnpore with cane which has always been grown from the cut-up whole cane; but unless such deterioration should manifest itself, it must mean a great saving to cultivators to plant from the top ends only.

"119. (1-2).—*The composition of the juice of different varieties of cane.*—The amount of juice expressible by the mill, and the proportion of the cane-sugar and glucose in the juice, has been determined for a number of varieties, some of which have been grown at the farms, some in villages at a distance from them. The amount and quality of the juice has varied a good deal between the worst and the best.

"The proportion of juice expressible will be dealt with under (7).

"The juice of the better varieties such as the *Poona Pandia*, the *Samadra* of Bengal, and the *Madras Pandia*, all contain high proportions of sugar varying from 14 to 18 per cent. of total sugar, and I am certain that no better cane can be obtained anywhere than these. Some of the thin varieties, too, such as the *Mafna* of the North-Western Provinces, *Mungo* of Behar and *Kadri* of Bengal, give a juice containing similarly high proportions of sugar. On the other hand, some such as the *Dikohun* and *Dhool* of the North-Western Provinces have much less sugar in their juice. Of the total sugar, the greater part is of course cane-sugar.

"The glucose has in most cases been determined in the juice also, and its proportion varies from a half up to two per cent.

"The acidity in the juice was determined in a number of samples in 1898, but the results obtained I consider uncertain. The colour of the juice is so dark that a difficulty was experienced in using 'indicators.' The question of the amount and the kind of acidity is nevertheless an important one, for, as will become evident when explaining the experiments which I made to prevent inversion when boiling the juice, this constituent causes a serious loss of crystallisable sugar. What is required is a method, both simple and rapid, for determining the amount of organic acids, other than carbonic acid, what may be used in the field, and I had not time to work one out.

"120. (2).—*The relation between the amount of sugar in sugarcane juice, and its specific gravity.*—Owing to the increasingly large number of analyses of juice which it was desirable to make in connection with these sugarcane experiments, and also to the fact that a chemist is only occasionally at the farms at the time of harvest, the need became apparent of some simple method of determining approximately the amount of sugar in juice.

"In the case of sugar being dissolved in pure water, its amount may be determined with very fair accuracy by observing the specific gravity of the solution, there being a very simple relation between the two.

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— Sugarcane juice is not, however, a solution of only sugar in water; other substances are present besides, which affect the density. It occurred to me, however, that the amount of these other substances might be fairly constant, and if so, the insertion of a uniform correction would enable one to calculate the percentage of total sugar from the specific gravity.

— Accordingly I compared the specific gravity of a large number of samples of juice with the amount of sugar actually found by analyses. The result of this was, that the difference between the percentage of sugar as shown by the hydrometer, and that actually present, proved to be fairly constant as I had expected. This difference amounted to about 2 per cent. in the majority of cases, and I calculated out a set of tables by means of which any one can find out the per cent. of total sugar with the aid of a hydrometer. Of course such a method is only approximate, but the result will not be more than half a per cent. from the truth. Also it is to be observed, one only learns the amount of total sugar by this means, but since the amount of glucose is only small, the method will be found very useful for field work, when the more exact methods of the chemist are not available.

— 121. (3) *The amount of inversion which takes place when boiling down the juice.*— All cane juice contains organic acids, and these at a boiling heat possess the unfortunate property of converting a part of the crystallisable cane-sugar into uncrystallisable glucose. So far as the food value of the resulting sugar is concerned, the change is probably of no great consequence.

— But in other respects the change is very serious. Not only are molasses useless and inconvenient to the refiner, to the small native refiner, just as much as to the large operator and European appliances, but to the *Bungys* who has to store the *gur* or *gul* through the season, the matter is of equal importance, because the larger the proportion of molasses, the more liable is the *gur* to liquify in his *godown*. I found that, whereas in the juice each 100 parts of total sugar includes usually from 2 to 10 parts of glucose, in the *gur*, as ordinarily made, the proportion of glucose ranged from 10 to 20 parts. In addition, it is to be borne in mind that each part of glucose will prevent an equal weight of cane-sugar from crystallising, so that these figures have to be doubled in order to express the true effect of the glucose formation. In endeavouring to find a means of preventing the change, it was necessary to employ only such a method as the ordinary cultivator could use, and I believe I have more or less succeeded. The addition of a small quantity of quicklime in water will neutralise the acidity of the juice, and thus prevent in a great measure the process of inversion. Too much lime must not, however, be employed, otherwise the resulting sugar becomes black, and its market value decreased. Litmus paper was at first employed to detect when sufficient lime had been added; later I found that there is a natural colouring matter in the juice which could be equally well employed.

— The result of the careful addition of lime is to prevent very materially the formation of molasses, and the *gur* obtained has a much better crystal. That which has been made at Cawnpore has realised distinctly a higher price in the bazar than that produced by simply boiling down the juice. Likewise in some experiments which I made in villages on Messrs. Thomson and Mylne's estate this year, the results were equally satisfactory.

— 122. (4) *The amount of sugar which becomes lost in the scum.*— When boiling down the juice, scum rises to the surface and is skimmed off more or less perfectly with ladles. The amount of this scum is considerable, and it seemed desirable to make one or two determinations of the amount of sugar which must of course be carried along with it.

— Accordingly in the cold weather of 1895-96 I estimated very accurately the amount of sugar actually present in the juice, and later, after the *gur* had been made, the amount of sugar in it. The difference between these two amounts is due to the sugar which had been carried away in the scum. Four experiments were made at Cawnpore and four at Poona. The loss of sugar proved to be from 10 to 14 parts per hundred in the juice.

— This sugar, which is unavoidably taken in the scum is, however, not wasted. At Poona the people recover part of it by putting the scum into water, boiling the liquid and then skimming off the scum. At Cawnpore the scum is given to cattle as a food.

— 123. (5).— *The Composition of the raw sugar.*— By far the greater part of the cane juice produced in India is simply evaporated down (after removing the scum) to such an extent that on cooling the mass becomes solid. This description of raw sugar is called *gur* in the South-Western Provinces and Bengal; in the Deccan it is called *gul*. Whilst still

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hot, the raw sugar is usually run into moulds where it solidifies in blocks weighing from 25 to 100 lbs. Sometimes, as in parts of Oudh, the *gur* is made up whilst warm and soft into rounded pieces about a couple of inches in diameter, and again in other districts, e.g. Dehra Dun, it is run out on bamboo matting whilst hot and allowed to solidify in thin cakes. These are, however, minor practices, and are not deserving of recommendation. Forms of the Oudh *gur* proved to be exceedingly dirty.

"The composition and colour of this description of raw sugar will vary very considerably, much depending on both the quality of the juice and the mode of working.

"If the cane becomes *laid* by rain, the juice will contain a high proportion of glucose (*vide* paragraph 117) and the resulting *gur* will be soft. Again, if the juice is passed through a cloth or brass wire strainer, much dirt and bits of cane are separated; it is indeed surprising how much dirt can be removed from the juice by this means. During the boiling process the more perfectly the skimming is effected, the purer will be the product and the better its colour.

"Finally, if the acidity of the juice be neutralised, the *gur* will contain a lower proportion of molasses (*vide* paragraph 121).

"Some samples of cultivators' *gur* from Oudh which I analysed, contained of cane-sugar from 63 to 72 per cent., glucose from 9 to 10 per cent., mineral matter from 1 to 1 per cent., water and other impurities from 15 to 24 per cent.

"The samples of *gur* made from *laid* cane at Cawnpore in 1895, contained from 64 to 68 per cent. cane-sugar and 13 to 14 per cent. glucose, whereas the *gur* from the erect cane of the same crop contained from 70 to 75 per cent. cane-sugar and 8 to 10 per cent. glucose. But with good cane and careful manufacture, the *gur* will contain from 70 to 75 per cent. cane-sugar and from 5 to 15 per cent. of glucose.

"124. In addition to the solid *gur* or *gul*, another description of raw sugar is prepared by removing the mass from the fire at a somewhat earlier stage, and before all the *gur* has been boiled out. The resulting sugar never solidifies entirely, but a great deal of the cane-sugar crystallises out during the first few days, and the mass becomes semi-solid. It goes by the name of *rib* in many parts, but in parts of Bengal it is also called *gur*.

"The composition of *rib* will vary somewhat according to the amount of water which is left in it. That made at Burdwan this year contained from 65 to 73 per cent. cane-sugar and 5 to 19 per cent. glucose, but one of the samples was undoubtedly below average for some reason or other. Other samples from Behar, which were prepared in my presence, contained from 60 to 75 per cent. cane-sugar and only 2½ to 5 per cent. glucose, and there is no doubt that, given good cane and careful manufacture, the latter standard can be maintained.

"This description of sugar is prepared specially for the purpose of refining. Frequently it is put into sacks which are then placed one on another in order to increase the pressure on the lower ones, and the molasses gradually run out more or less. Or again the refining process is effected by placing the *rib* in a vessel having a "false bottom." A wet weed (*senar*) is then placed on the surface, and the molasses gradually leave the top layer of sugar. This purified layer is then scraped off, and the *senar* applied to the next layer, and so on until the whole has been refined. In neither of these refining processes are the molasses obtained in a fit state for human consumption, and this means a loss of fully one-third of the sugar operated upon.

"One sample of sugar refined by this process contained 96·6 per cent. of cane-sugar and 0·59 per cent. glucose.

"125. (i) *The hand centrifugal sugar separator.*—Another much better means of separating the molasses from the sugar crystal of *rib* have been provided by Messrs. Burrows, Thomson and Myles of Behar, who have introduced a centrifugal machine, worked by one man at a time, by means of which the molasses are separated in a few minutes. About 26 sars of *rib* are placed in a machine at once, the separation is effected in about 25 to 30 sars, and the resulting sugar removed and the machine cleaned out ready for the next charge within 5 minutes. About 50 maunds of *rib* can be readily worked off in one day by each machine. The molasses are recovered quite clear and sweet and are boiled down to form solid *gur*.

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\* The proportion of clean crystallized sugar (what is called *brass sugar* in England) which is obtained, will of course vary somewhat with the nature of the *raf* operated upon. In one of Messrs. Thomson and Mylne's experiments a yield of 40 per cent. was obtained, another 33 per cent. In two experiments which I made 48.8 and 51.9 per cent. was obtained.

\* The amount of *gur* obtained after boiling down the molasses seems to vary between 25 and 40 per 100 of *raf* operated upon.

\* The so-called 'turbine' or 'centrifugal' sugar is very fairly pure. I have analysed several samples, from which it appears that it contains from 90 to 95 per cent. of cane-sugar, from  $\frac{1}{2}$  to 3 per cent. of glucose, from  $\frac{1}{2}$  to 3 per cent. of moisture, from  $\frac{1}{2}$  to 14 per cent. of mineral matter and from 2 to 3 per cent. of other (organic) impurities.

\* The *gur* obtained by boiling down the molasses is quite as good as much of the *gur* which is made by the cultivators direct from the juice. Judging by the composition of some samples which I have examined, it appears to have about the following composition:—*cane-sugar* from 65 to 80 per cent., glucose from 5 to 14 per cent., mineral matters from 3 to 4 per cent., water and other impurities from 10 to 20 per cent.

\* In addition to a regular trade which has sprung up in the Shahabad District in 'centrifugal' sugar, which is exported long distances by rail, a similar trade has arisen in the *gur* made from the molasses. I believe that a great future exists for this hand-centrifugal machine, for it is clear that a very material economy in sugar must take place by its means over the native processes in which the greater part of the molasses becomes unfit for human consumption, and thus actually lost entirely so far as food-supply is concerned.

\* 126. (1) *The total amount of sugar in sugarcane and the amount remaining in the crushed refuse.*—Since it is obvious that by no process of simple crushing, all the juice can be expressed from cane, it becomes an interesting question, how much is left with the refuse?

\* The matter is of far greater importance than might at first sight appear. It has generally been assumed in India that everything related to the crushing process depends entirely on the mill, and the question of difference in the variety of cane has rarely, if ever, been considered.

\* The first year's crushing of cane at the farms brought a very important fact to light, at Poona about 70 per cent. of juice was obtained from the cane there grown; at Cawnpore only about 50 per cent. was expressed. Since the mills which were used at the two places were essentially different, one might have said that the mills at Poona were infinitely better than those at Cawnpore. I knew, however, that such was not the case, some of the mills at Cawnpore having been of the very best workmanship and pattern.

\* The difference between 50 and 70 per cent. of juice is so great, that I decided to make some careful experiments in 1896 to find out what the true state of things really was. Accordingly the total amount of sugar and of juice was determined in two lots of the Poona cane at Poona, and in five different varieties grown at Cawnpore. The amount of juice expressed was also known, as well as amount of sugar in the latter, and the difference between the two gives the amount left in the crushed refuse cane.

\* (It may be here mentioned that I found it impossible, for technical reasons, to determine the amount of sugar in the refuse *directly*. When working in the field out of reach of my laboratory, only certain appliances can be used, and I had therefore to be content with taking the difference figure above indicated, as representing the quantity of sugar in the refuse.)

\* The methods employed are sufficiently clearly set forth in paragraphs 11 to 13 of *Agricultural Ledger No. 19 of 1896*.

\* The result of this investigation showed quite clearly on what factor depends the amount of juice which a good mill can express from sugarcane. The total amount of juice found in the two extreme cases examined varied from 85.2 to 91.5 per cent. The amount expressed from 45.4 to 72.2 per cent. A comparison of these figures throws no light on the subject, for there is obviously no simple relation between the two cases, in one 45 out of a total of 86 and in the other 72 out of a total of 91 per cent. of juice.



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"If, however, another item in the composition of cane, namely the fibre, be brought into the comparison, and its effect be considered, the cause of these variations is the amount of juice expressed becomes evident.

"It will be readily understood that so soon as cane is crushed up by the mill and the cells opened, the only physical force which prevents all the juice from running out is that of adhesion. The fibre of the cane becomes, in fact, a spongy material, and just as it is impossible to press all the water out of a wet sponge, so likewise is it impossible to express all the juice out of cane.

"But the analyses of the several varieties showed further that quite independently of the variety the crushed refuse cane contained approximately always the same amount of juice. At Poona the crushed cane consisted of 70 to 71 per cent. of juice and 29 to 30 per cent. fibre; at Cawnpore with entirely different mills and other varieties of cane, the refuse consisted of 72 to 75 per cent. of juice and 25 to 28 per cent. of fibre.

"Thus the proportion of juice in the crushed cane remained approximately constant, i.e. the fibre of these different varieties held approximately the same amount of juice in each case. Referring again now to the instances already alluded to, in one of which a cane contained 85 per cent. of juice and yielded only 45 per cent. at the mills, and in the other, the cane contained 91.5 per cent. juice and yielded 72 per cent. at the mills, if the amounts of crude fibre present in these canes be considered, its effect becomes apparent. The former contained 15 parts of fibre per 100 of fresh cane, and this 15 of fibre held 40 parts of juice, allowing only the other 45 parts to run out when pressed. In the second case, 100 parts contained 8.6 parts of fibre and this 8.6 parts of fibre held 19.5 parts of juice, allowing the remaining 72.2 parts to run out when pressed. And, as a result of this investigation, it may be said that, even with the best of mills, each part of fibre in the fresh cane will hold twice to two and a half times its own weight of juice when pressed, and allow only the surplus to run out.

"It becomes therefore an all-important matter in the selection of varieties of cane to choose those which contain low proportions of crude fibre. Speaking generally of varieties, I have found it almost uniformly the case that the small varieties commonly grown for crushing purposes in the North-Western Provinces and Behár, contain high proportions of crude fibre, and yield only some 50 to 55 per cent. of juice at the mills. On the other hand, the thick canes, some varieties of which are grown for chewing in the North-Western Provinces, others for crushing in Bengal and the Deccan, contain uniformly low proportions of crude fibre and yield from 65 to 79 per cent. of juice at the mills.

"Thus, even assuming that the juice of the thin varieties is just as rich in sugar as that of the thick ones (and it is probable that it is not so rich), the introduction of these varieties in place of thin ones, would mean a direct gain in sugar production of about 25 to 30 per cent. over that at present obtained, and this without any further expenditure on manure, water, &c.

"127. (8) *The amount of phosphoric acid and nitrogen in the sugarcane crop.*—At Poona the cultivators employ very large amounts of manure for this crop, and it has been further demonstrated by the field experiments that whilst it may be the case that these amounts are somewhat larger than is necessary, very heavy dressings of manure are desirable, and will readily repay the initial cost. So far as one can draw any conclusion from the three years' experiments, it would appear that 500 lbs. of nitrogen per acre should be given in order to obtain a full crop. The amount of phosphoric acid required is quite uncertain. Since it is necessary to apply such large amounts of manure, it seems desirable to gain a knowledge of the amount of these plant foods which are extracted from the soil by cane crops generally, and I made several determinations to this end. The cane, green tops, and dry leaves of crops at Cawnpore and Dumraon were weighed, and portions of each submitted to analyses. The results obtained showed that in crops weighing 60,000 to 70,000 lbs. there was generally contained some 50 to 60 lbs. of nitrogen and the same amount of phosphoric acid. The crops at Poona are fully twice as heavy as this, and it may therefore be said that they remove 100 lbs. or more of each of these plant foods. There is consequently a considerable balance unaccounted for. I have examined the results of the analyses of the Poona (Mánjri) farm soils, and judging by these, this balance of plant food is still in the soil, and no material amount has been lost by drainage up to the present.

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\*129. *Concluding remarks.*—As to the general importance of experiments on the sugarcane crop, it is almost unnecessary for me to say anything. It is clear in the first place that so long as India has to import sugar (the net amount is about 75,000 tons annually), there is room for an increased production. It is also clear that, whilst an article of diet, which is common to the people generally, is imported, the cost of production is higher than it should be. But this is not all, for the greater part of the sugar produced goes to the cities, and is thus becomes in a measure a luxury. Then, too, there is the difference between the returns per acre as realised in the Deccan and Bengal on the one hand, where, with good varieties and good methods of cultivation, some 2½ to 4 tons of raw sugar is obtained, and in Behar and the North-Western Provinces on the other, where the output is certainly not more than 1 to 1½ tons per acre, and is often much less.

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—As has been shown in the course of this section of my report, there is no need to go outside of India for good varieties, nor to other countries for good methods of cultivation. The best of varieties are met with; and the methods of cultivation in some parts are very perfect. What is wanted is the introduction of these good varieties and good methods into these parts, particularly the North-Western Provinces and Behar, which Provinces, it must be recollected, include much the largest area under cane of any Provinces of India."

## DESCRIPTION OF VARIETIES OF SUGARCANE.

By DR. LEATHER AND MR. MORRISON.

The following notes contain a description of a number of varieties of sugarcane which have been examined. It is possible that some of these are cultivated in other parts of India; doubtless also there are many other varieties which still remain to be described, and the writers think that the following introductory remarks will be of assistance to other agriculturists not only in the recognition of varieties included in these notes and growing elsewhere, but that they will assist of descriptions of other varieties being reduced to a common standard. It must be stated, however, at the outset, that, although among varieties of sugarcane each possesses particular markings or colours (to be presently dealt with in detail), there is usually in the case of any one particular variety considerable latitude within which appearances vary. For example, if a number of canes of the *Madrasí Punda* of the North-Western Provinces or the *Pundia* of Poona or the *Islands* of Bardwan be examined, it can be at once seen that the colour varies in any of these varieties from green to straw yellow, but the colour may be modified so that some canes may be almost entirely green whilst in others some portions may be entirely yellow or the yellow may have an orange tinge. The latter tinge is particularly noticeable in canes growing on the headlands and therefore rather fully exposed to the sun. In the *Madrasí Punda* this orange yellow colour is sometimes the general colour of the whole cane. The same variety may vary in shape between the nodes; a cane may be generally of, say type A (vide diagram at page 41), but some of the canes in the bundle may possess shape of type C, more especially at the lower end; or again some may have grown in type E at one part (frequently the upper end), the remainder being straight.

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2. Correspondingly great variations will be found among varieties in respect of other particulars, such as the extent to which aerial roots develop, the colour and shape of the rings at the nodes &c.

At the same time each variety is distinct, and when canes of two varieties are placed together, the differences become much more apparent than if they are separately examined.

Occasionally no differences can be detected between the striped canes of two varieties. For example, the *Mungo* and *Bauri* canes of Behar are so much alike that they are indistinguishable when stripped of the leaves; the leaves of the two are, however, quite distinct, those of the *Mungo* being of a paler green and inclined to crumple up, whilst those of the *Bauri* variety are darker in colour and remain flatter. Such a case is, however, in the experience of the writers, exceptional, and varieties as a rule are sufficiently distinct to enable one to recognize them without the leaves. In fact the leaves are commonly of but little assistance in determining the variety.

3. In the following paragraphs the points which have been more particularly examined are dealt with in detail.

**Colour.**

4. **Colour**—Sugarcane may be of the following colours:—

- (1) Pale yellow or drab.
- (2) Pale yellow and green.
- (3) Nearly entirely green.
- (4) Purple or purple red.
- (5) Purple and yellowish green in stripes.
- (6) A more or less intimate mixture of dull purple and dull green best described as a dirty colour.

Of these, however, only (4), (5) and (6) are really so distinct that the cane can be definitely said to belong to the one or the other. A striped cane for instance is always striped purple with yellow or yellow-green. A cane that might be classed as wholly purple, when minutely examined, may or may not have longitudinal stripes of a darker or lighter colour, these being most distinctly marked on the upper internodes and only faintly marked on the lower. In purple canes the depth of colour may vary from very dark purple to a light reddish purple. It is at times practically impossible to decide whether a particular cane should be classed as pale yellow or drab, or pale yellow and green, and again it is hard to differentiate between pale yellow and green and nearly entirely green. It has been found that some varieties are almost or quite destitute of green in a certain field, e.g., *Betta Kabba* at Belgaum and *Dhaur* and *Rakra* in the North-Western Provinces; but tinges of green are frequently found on the same variety when cultivated under other conditions, e.g., *Betta Kabba*, which at Poona had tinges of green on it. The same may be said of canes being

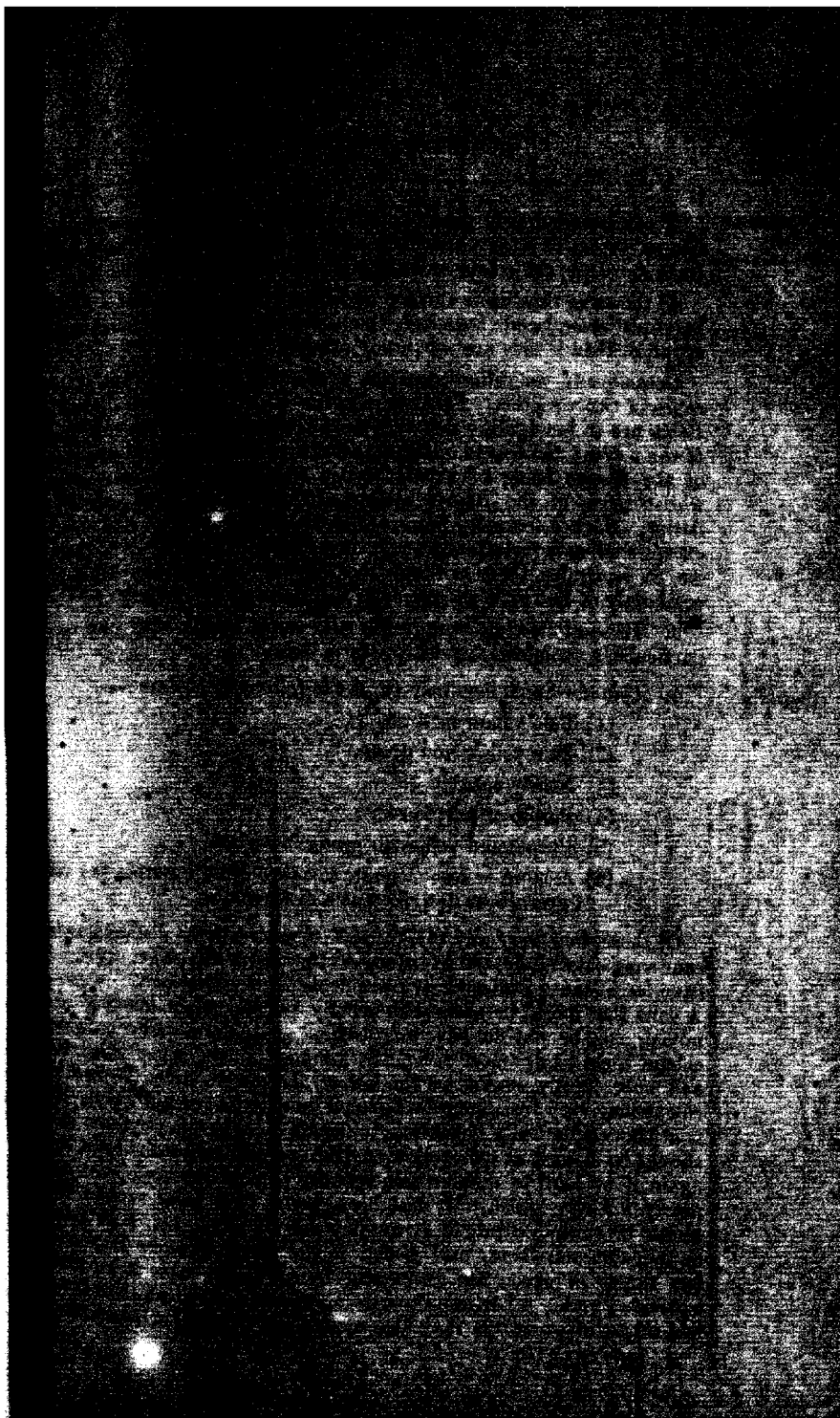
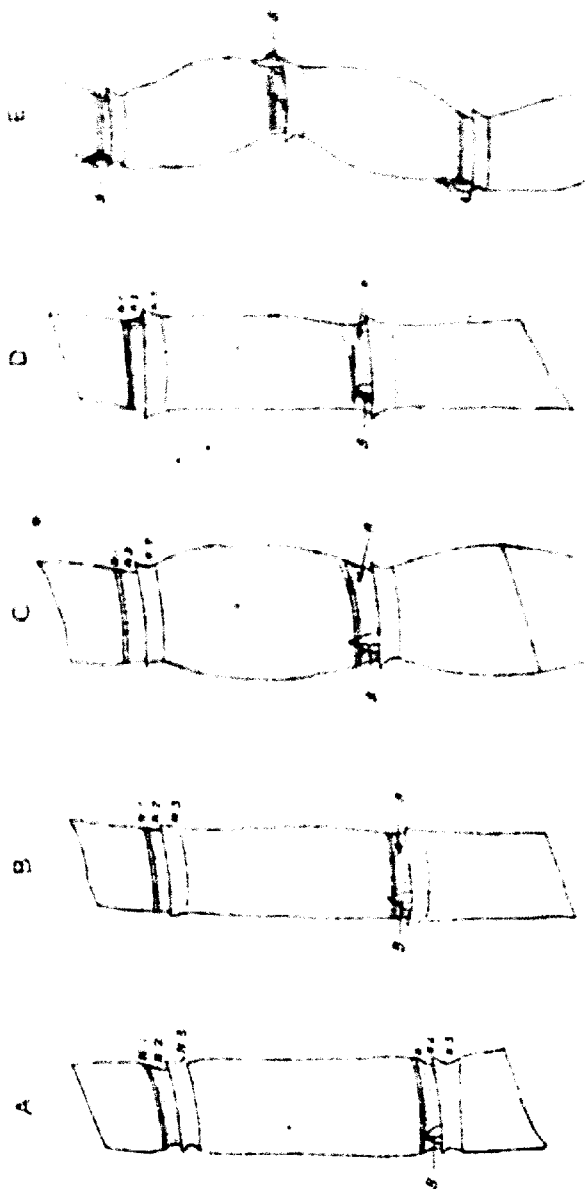


DIAGRAM SHOWING DIFFERENT TYPES OF CANE



Bombay Presidency. (J. W. Leather &amp; J. Mallison.)

SACCHARUM:  
SUGAR.DESCRIPTION  
OF  
SUGARCANE.

all green. Sometimes a variety will be quite destitute of yellow in a certain field, but the same variety will be found in another field or locality to be quite yellow in places. For example the *Mungo* at Rana was entirely green, whilst at Bára Banki it was partly yellow. The simplest plan is therefore to class all canes of a yellow or yellowish-green or green colour together and state the colour as found in a particular variety when examined.

Canes might then be divided into four classes as regards colour:—

- (1) Yellow or green or both.
- (2) Purple.
- (3) Purple and yellowish green in stripes.
- (4) Purple and green mixed to form a dirty colour.

It not infrequently happens that a yellow green cane will have very distinct patches of red or pink upon it. Such for example is the *Kasrie* of Sitápur District, North-Western Provinces. But this is quite distinct from the purple colour of canes belonging to classes 2 and 3.

5. *Other points of colour.* In reference to the colour of canes several other points are deserving of notice.

Very frequently patches or smudges of dirty black are found clinging to a cane. This is quite external and may readily be rubbed off. It cannot be said that these smudges are characteristic; they are found on some varieties, not on others growing in the same field and the origin of the smudges has not been determined. Then tinges of pink or red appear on some canes, especially just above the nodes where the leaf still adheres. This colour is not always on every cane of one variety in the same field but is apparently a common characteristic on some varieties. For instance the *Kasrie* cane of the North-Western Provinces was tinged with pink at Sitápur (Oudh) and in one of the fields examined at Bára Banki (Oudh), but in another field of this variety at Bára Banki this colour was almost entirely absent.

6. *Bloom.*—There is on some varieties a mass of waxy bloom which covers the cane more or less, and the presence or absence of this bloom, as also the degree to which it covers a cane seems to be quite characteristic of varieties.

Bloom.

7. *General shape of Cane.*—Sugarcanes have very characteristic shapes, some of the principal ones being depicted in the accompanying figures and shown as A, B, C, D, and E. Of these the first three are the most common.

General  
shape.

presents one which has distinct contraction at the nodes, but fine a cane of practically uniform thickness.

# **SACCHARUM: SUGAR.**

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### **DESCRIPTION OF SUGARCANE.**

B—represents a cane which is practically of uniform thickness throughout its length there being no perceptible contraction or expansion at the nodes.

C—represents a cane which is contracted at the nodes and becomes distinctly enlarged between the nodes.

D—represents one in which the nodes are distinctly larger than the cane and it then becomes narrower between the nodes. This apparently is not a common shape.

Finally, E—represents a cane which has a zigzag form from joint to joint.

### **Colour of nodes.**

8. *Colour of Nodes.*—The nodes of canes are very characteristically coloured or marked. There are always two bands, one immediately above the node marked  $N_2$  in the diagram. This is about as broad as the buds are long *before they commence to grow*; also it is from this band that the roots develop either as aerial roots or when cane sets are planted. The little dots or growing points of the future roots are always perceptible. In some varieties they are much more distinct than in others. In fully mature canes the root dots of the lower nodes present a roughened appearance as if the roots had started to grow. At the upper nodes they present a smooth surface. The colour of the root dot band varies but is generally lighter coloured than the main part of the cane. Immediately *below* the node is another band, marked  $N_1$  in the diagram, of about the same breadth as the upper one. This band is generally of a grayish or bluish gray colour occasioned partly by the coating of wax which is invariably present on this part of a cane, however little wax may be attached to other parts; the gray colour commonly terminates suddenly, thus making a very distinct band, and sometimes however extends downwards on the main part of the cane and only gradually changes to the general colour of the cane. Such is the case for example on some canes of *Hulla Kubba* of Belgium.

### **Shape of band.**

9. *Shape of Band.*—The shapes of these two bands also vary. Sometimes the cane is contracted at both bands, but more commonly the contraction is only slight at the upper one but considerable at the lower one. The different types of nodes are graphically represented in the diagram, of which A, B, and C are very common. In addition to these, there is a ring marked  $N_1$  in the diagram, which is common to many varieties, but almost, if not quite, absent in the case of others. The ring, if distinct, is about  $\frac{1}{4}$ " wide, and is commonly of a decided orange colour. Very frequently, however, it is not uniformly distinct in any one variety, and not of uniform width or prominence on all the nodes of the same variety.

### **Buds.**

10. *Buds.*—The buds vary in shape, size and colour among varieties, but since their shape and colour vary according to whether they have commenced to grow or not, care must be taken to note this point in examining them. At the same time on some varieties

## Bombay Presidency. (J. W. Leather &amp; J. Mallina.)

SACCHARUM  
RUMI  
Sugars.

(if not over-ripe) they are uniformly rounded or oval, whilst in the case of others they are more pointed. In some varieties the scale-like covering which protects the buds is coarse and fibrous in texture, in others it is smooth, thin and shining.

11. *Root Dots*.—Regarding the little dots, indicating the seat of the growing point of the future root, not much need be said. They are distinct on some varieties but only just perceptible on others.

12. *Aerial Roots*.—Sugarcanes have a general tendency to throw out aerial roots from the nodes which are near the ground, but some varieties produce them not only close to the ground, but for some distance up the cane. Occasionally this is a very pronounced characteristic. For example the *Sháhárampuri* and the *Madrasí* or *Madrasí* *Parade* of the North-Western Provinces and the *Samudra* of Bengal frequently produce them over its entire length and moreover the aerial roots of one node grow towards and join those of the next node.

13. *Girth*.—The girth of canes varies apparently not only between varieties, but also according to the perfection of growth of the variety. Generally, however, it may be said that the girth of a thin specimen of any one variety will not be less than  $\frac{3}{4}$ th of that of a really good specimen of that variety. For this reason the girth of a cane is a most important consideration. If an unknown variety has a general thickness of 2" but is similar in other points to one having a general girth of 4", it may be said with certainty that they are different varieties. The girth of some varieties is almost uniform throughout the entire length. On the other hand sometimes canes are thinner at the top end than the bottom and less frequently they are thinner at both ends than at the middle.

14. *Length between Nodes*.—The length between the nodes of a cane varies very considerably, but nevertheless well grown canes of all varieties appear to be characterised more or less in this particular.

The *Halla Kabhu* of Belgaum, for example, has generally long inter-nodes, whilst the *Betta Kabhu* of Belgaum has frequently short ones. The *Malabári* cane of Surat has generally long inter-nodes. The *Mera* cane of the same district has invariably short inter-nodes. If a crop of cane of any variety is stunted in growth for want of manure or any other cause the inter-nodes are invariably short.

15. But although such broad distinctions as the above may be made between canes generally, it is not always easy to decide to which variety a cane belongs. The shape of canes and their colours merge in a measure the one into the other.

In the case of colour, any cane may be easily placed under one of the four groups which have been suggested, but in the case of the colour and distinctness of the bands at the nodes, whether the ring (marked R in the diagram) is distinct or not, whether a cane is enlarged or

DESCRIPTION  
OF  
SUGARCANE

Root dots.

Aerial roots.

Girth.

Length  
between  
nodes.General  
remarks.



SACCHARUM:  
SUGAR.

## Cultivation of Sugarcane in the

Description  
of  
SUGARCANE.

contracted between the nodes &c., whether aerial roots are common to a variety, what the shape of the buds is &c. &c., it is frequently difficult to say positively what would be an accurate description for any one variety. Nevertheless if, in describing canes the various points be noted on the above indicated lines, descriptions given by different persons of the same variety would probably agree more completely, than if such descriptions were referred to no general standard.

Vernacular  
Names.

16. *Vernacular Names.* That the cultivators can recognise the varieties of their particular district there is not the least doubt, and if they all spoke the same tongue the recognition of the many varieties grown in India would be a very simple matter. Unfortunately the names given by the people are not always of much value.

In the North-Western Provinces and Oudh not much difficulty has been experienced in this respect.

In the Southern Marátha Country, however, much confusion exists among the names as the following instances will show. There are three thick canes grown, one being a green-yellow cane (the *Pundia* of Poona), a second is entirely purple and the third is striped purple and yellow-green.

The *Pundia* is called *Pundia* throughout the Southern Marátha Country, but it is also called *Bilo Kabbu* (i. e. white cane) and *Rasdi Kabbu* at Dhárwár. The purple cane is generally called *Káru Kabbu*, but is also called *Rasdi Kabbu* in some villages. The striped cane is called *Rasdi*, *Rasdi*, *Rasdi* or *Rámrasdi*.

When one enquires into the meaning of these words the cause of the confusion becomes apparent. *Bilo* means "white," and is doubtless applied by the people to that variety of the three which is yellowish green in colour (that is lightest in colour) to distinguish it from the purple ones.

*Rasdi* or *Rasdi* or *Rasdi*, all of which are probably the same word differently pronounced, means juicy, and the term is applied to all the three varieties because they are more juicy than the thin varieties also grown in the Southern Marátha Country.

In the name *Rámrasdi*, the prefix *Rám* is derived from *Rama* = God, and is probably applied to the striped cane because it is the prettiest of the three.

17. In finding the different varieties of cane in a district the cultivators have been found of the greatest assistance to the writers; they will readily indicate the fields in which the different varieties are grown and the measurements and other descriptive remarks may then be made without any trouble.

Juice of  
cane.

18. *The juice of canes.*—The foregoing has only reference to the appearance and size of canes. It remains to say a word with regard to the juice.

The percentage of juice obtainable in the iron mill from any variety  
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(James Morrison.)

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RUM:  
Sugar.VARIETIES  
OF CANE  
EXAMINED

apparently fairly constant. (Fide for example the varieties grown at Belgum and Dhárwar described further on.)

So far as the experience of the writers goes, thick canes will give from 68 to 72 per cent., while from thin ones only 50 to 60 per cent. will be obtained. Consequently it is most important to find out if this rule may be relied upon. The subject is dealt with more fully in *Agricultural Ledger No. 19 of 1896*, at pages 18-20. The proportion of juice extractable may be readily determined by passing about 100 lbs. of cleaned cane of any one variety through an iron mill and weighing the juice obtained. The percentage of sugar in the juice can be approximately determined from the specific gravity, and this subject has been dealt with in a special paper on the chemical composition of sugarcane, *Agricultural Ledger Series No. 3 of 1897*.)

## DETAILED DESCRIPTION OF DIFFERENT VARIETIES OF SUGARCANE.

### (A).—BOMBAY PRESIDENCY VARIETIES.

(Examined by MR. MORRISON.)

*Variety*—**Khajuria** or **Meva**.KHAJURIA  
OR MEVA.*Where grown*—Surat District.

*General Appearance*—A yellow green cane of medium thickness; tall and fairly soft; used only for raw eating; tillers freely; ratoons well; grows in clumps.

*Type*—C; internodes only slightly bulged.*Bloom*—A little.*Nodes*—Ring  $N_1$ —Not distinct.

Band  $N_2$ —Irregular in shape; yellow or cream colour; root dots well marked.

Band  $N_3$ —Well defined; blue-grey colour.

*Height*—About six feet without tops when well grown.*Girth*— $3\frac{1}{2}$ " to  $3\frac{3}{4}$ "; almost uniform from root to top.*Internodes*— $2\frac{1}{2}$  to 3 inches; characteristically short.*Aerial Roots*—On 3 or 4 nodes near root only.

*Buds*—Very prominent; rounded; sharp point; covered with shining scale-like covering, except on lower nodes, where the covering is brown and fibrous.

# **SACONIA RUM Sugar**

**VARIETIES  
OF CANE  
EXAMINED.**

## **Cultivation of Sugarcane in the**

DR. LEATHER'S Analysis—	Poona Farm Exp.	
	1896. (Fresh imports.)	1897. (Acclimatized 1 year)
Percentage of juice to cane ...	50.15	67.25
Do. of sugar to juice ...	10.38	14.80
Do. of glucose in juice ...	1.40	1.00

**MALABARI.**

*Variety*—Malabari.

*Where grown*—Surat District.

*General Appearance*—A fairly thick, tall, soft cane; yellow-green colour; cane generally somewhat bent at top end; does not ratoon well.

*Type*—C; internodes fairly bulged.

*Bloom*—Very little.

*Nodes*—Ring N<sub>1</sub>—Indistinct on lower nodes; fairly well marked on upper nodes; pale yellow and green.

Band N<sub>2</sub>—Yellow and green; root dots well marked.

Band N<sub>3</sub>—Light blue-gray colour.

*Height*—7½ to 9 feet, without tops, when well grown.

*Girth*—1" to 4½".

*Internodes*—3½" to 5½".

*Aerial Roots*—On 3 or 4 lower nodes only.

*Buds*—Very small; covered with fibrous dull-brown covering.

**VANSI OR  
BAMBOO;  
BETTA  
KABBU.**

*Variety*—Vansi or Bamboo, same as Betta Kabbu of Southern Maratha Country.

*Where grown*—Surat District; Belgaum.

*General Appearance*—A cream coloured or light yellow cane; vertically scored with black or brown lines; very tall; thin and hard, of uniform thickness throughout; the leaves are narrow and long and the dried dead leaves enclose the cane, and thus protect it from damage by jackals and pigs.

*Type*—B.

*Bloom*—Good deal; black patches numerous.

*Nodes*—Ring N<sub>1</sub>—Distinct dull yellow colour.

Band N<sub>2</sub>—Regular in width; cream colour; root dots not numerous, and not distinctly marked.

Band N<sub>3</sub>—Not well marked; light-gray colour; sometimes nearly white.

## Bombay Presidency.

(James McEason.)

SACONIA-  
RUM:  
Sagan.VARIETIES  
OF CANE  
EXAMINED.*Height*—Without tops 8 feet; some canes 10 feet long, when well grown.*Girth*—2½" to 2¾".*Internodes*—3½" to 5".*Aerial Roots*—On 4 to 6 lower nodes.*Buds*—Rounded small; not prominent; shining light green scale covering on upper, and brown or khaki scales on lower buds.

DR. LEATHER'S Analysis—	Belgaum Crop, (Beta Kabbu) 1896, (Local)	Poona Farm Crop, (Bambhu or Vanshi) 1896, (Fresh imports)	1897, (Acclimated 1 year.)
	1896,	1896,	1897
	(Local)	(Fresh imports)	(Acclimated 1 year.)
Percentage of juice to cane ...	60.00	57.70	59.00
Do. of sugar to juice ...	12.64	9.53	14.50
Do. of glucose in juice ...	0.95	1.54	1.00

Variety **Bhuri**.

BHURI.

*Where grown*—Surat District.*General Appearance*—A fairly tall, moderately thick, hard cane; the colour varies between the lower and upper internodes considerably; the lower ones are a dirty-looking admixture of brown, dull purple, and dull green; the upper nodes are dull purple mixed with a good deal of dull green; the canes are mostly scored or blotched with gray.*Type*—E; only slightly zig-zag in shape.*Nodes*—Ring N<sub>1</sub>—Not very distinctly marked.Band N<sub>2</sub>—Distinctly marked but varies with the cane in colour between upper and lower nodes; root dots very prominent.Band N<sub>3</sub>—Hardly observable in lower nodes; a ring of grey bloom on upper nodes.*Height*—Without tops 6 to 7 feet when well grown.*Girth*—3½" to 3¾".*Internodes*—3½" to 4½".*Buds*—Fairly large; flattened; pointed; covered with fibrous khaki coloured scales.*Aerial Roots*—On lower nodes.Variety—**Phojbhuri**.

PHOJBHURI.

*Where grown*—Surat District.*General Appearance*—Very like *Bhuri* in appearance, excepting that the colour is yellow green on upper internodes, but irregularly tinged here and there, with brown and purple on lower internodes.

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RUM:  
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**Cultivation of Sugarcane in the**

**VARIETIES  
OF CANE  
EXAMINED.**

*Type*—E; only slightly zig-zag in shape.

*Bloom*—A little.

*Nodes*—Ring N<sub>1</sub>—Faintly marked.

Band N<sub>2</sub>—Irregular in width; yellow or green in colour; root dots fairly distinctly marked.

Band N<sub>3</sub>—Faintly marked on lower nodes, but more distinctly on upper; blue-gray colour.

*Height*—6 to 7 feet when well grown.

*Girth*—3½" to 4".

*Internodes*—3½" to 4½".

*Buds*—Medium size; flat; pointed; covered with khaki coloured scales.

*Aerial Roots*—On lower nodes.

**SONGADI.**

*Variety*—**Songadi.**

*Where grown*—Surat District.

*General Appearance*—A dull purple mixed with dull green; scored irregularly with khaki coloured marks; this cane is tall, hard, and nearly of uniform thickness throughout the whole length.

*Type*—E.

*Bloom*—None.

*Nodes*—Ring N<sub>1</sub>—Very wide and irregular in shape; varies in colour, generally purple.

Band N<sub>2</sub>—Irregular in shape, and colour; root dots distinct and lighter in colour; thin band.

Band N<sub>3</sub>—Regular in shape, but varies in colour throughout the length of the cane in a very erratic manner.

*Height*—8 to 10 feet without tops, when well grown.

*Girth*—3½" to 4".

*Internodes*—5" to 6".

*Aerial Roots*—On lower nodes only.

*Buds*—Fairly large, flat, pointed, and khaki coloured.

**KALI JADI.**

*Variety*—**Ka'li Ja'di.**

*Where grown*—Surat District.

*General Appearance*—A tall, hard cane of almost uniform thickness from root to top; dull purple in colour; scored and blotched with khaki colour.

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Bombay Presidency.

(James Morrison.)

SACONHA  
HUM  
Sugar.VARIETIES  
OF CANE  
EXAMINED.*Type*—E; but internodes only slightly zig-zag.*Bloom*—A little.*Nodes*—Ring  $N_1$ —Indistinct on lower nodes; distinct and yellow-green colour on upper nodes.Band  $N_2$ —Purple with faintly marked root dots on lower nodes; pale green on upper nodes.Band  $N_3$ —Distinct band of blue-grey bloom.*Height*—6 to 7 feet, when well grown.*Girth*— $3\frac{1}{2}$ " to 4".*Internodes*—4" to  $4\frac{1}{2}$ ".*Aerial Roots*—Very few.*Buds*—Small, flat, blunt, and *khatti* coloured.*Variety*—Deogadi.*Where grown*—Ratnagiri District.*General Appearance*—A very tall, straight, fairly thick cane; moderately hard; smooth; yellow and pale green in colour.*Type*—A; internodes very slightly bulged.*Bloom*—Very slight.*Nodes*—Ring  $N_1$ —Distinctly marked; very regular in width; narrow; varies in colour, mostly deep yellow.Band  $N_2$ —Very regular; distinctly marked; green-yellow in colour; root dots numerous and very distinct.Band  $N_3$ —Grey-blue in colour and very distinct.*Height*—7 to 8 feet without tops; very well grown canes over 10 feet without tops.*Girth*— $3\frac{1}{2}$ " to  $4\frac{1}{2}$ "; middle internodes slightly thicker than lower and upper ones.*Internodes*— $3\frac{1}{2}$ " to  $5\frac{1}{2}$ ".*Aerial Roots*—None.*Buds*—Small, rounded, fairly sharp points; covered with a shining scale covering; varies in colour.DR. LEATHER'S *Analysis*—

		Poona Farm Crop.	
		1896, (Fresh imports.)	1897. — (Acclimatized 1 year.)
Percentage of juice to cane	...	70.50	68.0
Do. of sugar to juice	...	11.46	14.0
Do. of glucose in juice	...	1.87	0.0

DEOGADI.

**SACCHA-  
RUM:  
Sugar.**

VARIETIES  
OF CANE  
EXAMINED.  
MÁHIM YEL-  
LOW GREEN;  
PUNDIA.

**Cultivation of Sugarcane in the**

*Variety*—**Máhim Yellow Green**, same as Poona Pundia and Pundia of Belgaum, &c.

*Where grown*—Máhim, Thána District.

*General Appearance*—A thick, soft, tall cane tapering to small nodes at the top; yellow green in colour; cane generally bent, or crooked.

*Type*—C; internodes bulged considerably, especially at the top end; cane much inclined to crack vertically before ripening like all the thick varieties; ratoons well.

*Bloom*—Good deal.

*Nodes*—Ring  $N_1$ —Irregular; not particularly noticeable; orange.

Band  $N_2$ —Wide and irregular in shape; yellow or yellowish green; root dots numerous and easily seen.

Band  $N_3$ —Wide; distinct; blue grey in colour.

*Height*— $7\frac{1}{2}$  to 9 feet without tops; some canes 10 feet long.

*Girth*— $4\frac{1}{2}$ " to 5".

*Internodes*— $3\frac{1}{2}$ " to 5".

*Aerial Roots*—Few or none.

*Buds*—Rounded, prominent, moderate in size; covered with dull brown or kháki fibrous covering.

DR. LEATHER'S *Analysis*—

	Poona Farm Crop.			Belgaum Crop.
	(Máhim Yellow Green.) 1896. (Fresh im- ports.)	1897. (Acclima- tized 1 year.)	1896. (Local.)	
Percentage of juice to cane ...	71.00	70.68	68 to 73	64.50
Do. of sugar to juice ...	12.34	14.80	16 to 17.4	13.71
Do. of glucose in juice ...	1.67	0.90	1.2 to 1.6	0.83 to 1.0

GREEN  
MAURITIUS.

*Variety*—**Green Mauritius**.

*Where grown*—Imported in 1893 by the Bombay Agricultural Department.

*General Appearance*—A tall, moderately thick, fairly hard cane, lower internodes green; colour changes gradually towards the top to a pale yellow tinged with green; cane flowers freely, and inclined to produce side shoots prematurely; it tillers well, and ratoons well.

*Type*—A.

*Bloom*—None.

S. 126—40.

## Bombay Presidency.

(James Mollison.)

SACCHA-  
RUM;  
Sugar.VARIETIES  
OF CANE  
EXAMINED.

*Nodes*—Ring  $N_1$ —Well marked; rather wide; much the same colour as the cane.

Band  $N_2$ —Mostly pale yellow tinged with green; regular in width; root dots fairly well marked.

Band  $N_3$ —Distinct; light blue grey in colour.

*Height*—7 to  $7\frac{1}{2}$  feet without tops.

*Girth*— $3\frac{1}{2}$ " to 4".

*Internodes*— $3\frac{1}{2}$ " to  $4\frac{1}{2}$ ".

*Aerial Roots*—Few or none.

*Buds*—Round; fairly prominent; slightly pointed; covered by a light *khaki* fibrous covering.

Dr. LEATHER'S *Analysis*—

	Poona Farm Crop.	
	1896.	1897.
Percentage of juice to cane ...	65.70	68.75
Do. of sugar to juice ...	14.71	14.10
Do. of glucose in juice ...	0.29	1.40

*Variety*—**Rasda li**; **Rasva li**; **Rasa li**: that is, juicy.

*Where grown*—Haliál, Kánara District.

*General Appearance*—A tall, fairly hard, yellow green cane of moderate thickness.

*Type*—A.

*Blow*—Little or none.

*Nodes*—Ring  $N_1$ —Distinct; narrow; varies in colour; mostly green or yellow.

Band  $N_2$ —Wide; fairly regular in width; root dots numerous and distinct.

Band  $N_3$ —Wide; distinct; blue grey in colour.

*Height*—7 to  $7\frac{1}{2}$  feet without tops, when well grown.

*Girth*— $3\frac{1}{2}$ " to 3".

*Internodes*—5" to 6".

*Buds*—Small; prominent; rounded; covered by brown or *khaki* scales.

Dr. LEATHER'S *Analysis*—

	Poona Farm Crop.	
	1896. (Fresh Imports.)	1897. (Acclimatised 1 year.)
Percentage of juice to cane ...	60.40	62.14
Do. of sugar to juice ...	13.18	15.30
Do. of glucose in juice ...	1.49	1.00

S. 126—40.

RASDA LI;  
RASVA LI;  
RASA LI.



# MACCHA- RUM: Sugar.

VARIETIES  
OF CANE  
EXAMINED.  
YELLOW  
GREEN.

## Cultivation of Sugarcane in the

**Variety—Yellow Green.**

**Where grown—**Bijapur; Bágalkot.

**General Appearance—**A yellow green cane; fair in length and thickness; slightly scored with brown; lower internodes not so thick as those in middle of cane.

**Type—**A; sometimes C; internodes very slightly bulged.

**Bloom—**A little.

**Nodes—**Ring  $N_1$ —Distinctly marked in upper nodes but not so distinct on the lower ones; varies in colour, but commonly part of ring, bright brown.

Band  $N_2$ —Distinctly marked; pale green and yellow in colour; root dots very distinctly marked.

Band  $N_3$ —Very distinct and regular; of blue grey colour.

**Height—**8 to  $8\frac{1}{2}$  feet without tops, when well grown.

**Girth—**4" to  $4\frac{1}{2}$ ".

**Internodes—**Very regular in length  $4\frac{1}{2}$ " to 5".

**Aerial Roots—**None.

**Buds—**Small; rounded; pointed; covered with khaki coloured scales.

**DR. LEATHER'S Analysis—**

	Poona Farm (Bijapur Yellow Green) 1896, (Fresh imports).	Chop. (Bágalkot Yellow Green) 1897, (Acclimatized 1 year.) (Fresh imports.)	Chop. (Bágalkot Yellow Green) 1896, (Acclimatized 1 year.) (Fresh imports.)
Percentage of juice to cane ...	70.40	70.62	68.10
Do. of sugar to juice ...	14.30	18.60	12.31
Do. of glucose in juice ...	1.57	1.10	1.91

# HULLU KABBU.

**Variety—Hullu Kabbu** (Hullu—grass and Kabbu—sugarcane).

**Where grown—**Southern Marátha Country.

**General Appearance—**A very thin, tall, hard cane; yellow green in colour; generally bent towards the top; many dirty patches; cane securely enclosed in dead side leaves; tillers freely; ratons well.

**Type—**Generally B.

**Bloom—**Good deal.

**Nodes—**Ring  $N_1$ —Orange yellow, tinged with green on upper nodes.

Band  $N_2$ —Dull yellow; root dots distinct.

Band  $N_3$ —Grey.

S. 126—40.

Bombay Presidency.

(James Mallison.)

**SACCHARUM:**  
**Sugar.**

**VARIETIES**  
**OF CANE**  
**EXAMINED.**

*Height*—7 to 8 feet; some canes 10 feet without tops, when well grown.

*Girth*—1½ to 2".

*Internodes*—5 to 7".

*Aerial Roots*—A few on lower nodes only.

*Buds*—Slightly prominent; elliptical; lower buds covered by brown scales; upper ones light green in colour.

*DR. LEATHER'S Analysis*—

	Poona Farm Crop.		Belgaum Crop.
	1896. (Fresh imports)	1897. (Acclimatized 1 year.)	1896. (Local.)
Percentage of juice to cane ...	52.00	56.17	55.00 to 59.80
Do. of sugar to juice ...	16.06	16.90	14.27 to 14.92
Do. of glucose in juice ...	A trace only.	0.70	A trace to 0.74

*Variety*—Yellow Green.

*Where grown*—Rānebennur, Dhārwar District; and Chikodi, Belgaum District.

*General Appearance*—A light green or yellow cane; moderately thick; fairly tall and soft.

*Type*—A; sometimes C; internodes slightly bulged (nodes not prominent).

*Bloss*—Some.

*Nodes*—Ring N<sub>1</sub>—Distinctly marked; narrow; dull orange brown in colour, which, however, varies in lower nodes.

Band N<sub>2</sub>—Distinctly marked; wide; root dots distinct and numerous.

Band N<sub>3</sub>—Distinct; wide; dull grey in colour.

*Height*—6½ to 7 feet without tops, when well grown.

*Girth*—3" to 4".

*Internodes*—3" to 5".

*Aerial Roots*—None.

*Buds*—Small; round or oval; blunt; covered by dull khaki scale-like covering, which gets fibrous on lower buds.

*DR. LEATHER'S Analysis*—

	Poona	Farm	Crop.
	(Chikodi Yellow Green.) 1896. (Fresh imports.)	1897. (Acclimatized 1 year.)	(Rānebennur Cane.) 1896. (Fresh imports.)
Percentage of juice to cane ...	65.50	68.17	61.10
Do. of sugar to juice ...	11.35	11.90	12.04
Do. of glucose in juice...	1.80	1.90	1.48

S. 128—40.

**YELLOW**  
**GREEN.**

**SACCHA-  
RUM :  
Sugar.**
**VARIETIES  
OF CANE  
EXAMINED.**
**SANNA  
BILE  
KABBU.**
**Cultivation of Sugarcane in the**

**Variety**—**Sanna Bile Kabbu** (*Sanna* = small, *Bile* = white, *Kabba* = sugarcane.)

**Where grown**—Khánápur; Southern Marátha Country.

**General Appearance**—A tall, straight, yellow cane, tinged irregularly with pale green with vertical red brown scores at lower end; characteristic bright orange red colouring on leaf sheaths of upper leaves; dry leaves closely enclose the cane; many dirty patches on cane tillers freely, and ratoons well.

**Type**—B.

**Bloom**—A little.

**Nodes**—Ring  $N_1$ —Very distinct; deep yellow; fairly narrow.

Band  $N_2$ —Cream colour well marked; root dots fairly distinct.

Band  $N_3$ —Distinct; light blue, grey colour.

**Height**—8½ to 10 feet without tops, when well grown.

**Girth**—3¼" to 4"; uniform.

**Internodes**—4" to 4½".

**Aerial Roots**—Hardly any.

**Buds**—Small, rounded, and prominent; lower buds *kiki* coloured; upper buds pale yellow and green.

**DR. LEATHER'S Analysis —**

	Poona Farm Crop.	Khánápur Crop.
	1896, (Fresh imports.)	1897. (Acclimatized 1 year.)
		1898. (Local)
Percentage of juice to cane ...	60.03	58.20
Do. of sugar to juice...	17.38	16.00
Do. of glucose in juice ...	0.68	0.90

**RED OR  
PURPLE  
MAURITIUS.**

**Variety**—**R or Purple Mauritius.**

**Where grown**—Imported in 1893 by the Bombay Agricultural Department.

**General Appearance**—A tall, thick, hard cane; general colour purple, or bright purple on lower internodes; the colouring gets lighter and brighter towards the upper internodes; distinct, almost black, vertical stripes in most of the internodes resembling streaked cane; the cane has a shining appearance; leaves sometimes variegated in colour; tillers freely; inclined to flower, also to produce side shoots profusely.

**Type**—A.

**Bloom**—None.

**S. 128—40.**

## Bombay Presidency.

(James Mallison.)

**SACCHA  
RUM:  
Sugar.**VARIETIES  
OF CANE  
EXAMINED.

*Nodes*—Ring  $N_1$ —Very distinct, and except in lower nodes of cream colour.

Band  $N_2$ —Colour variable but always lighter than the general colour of the cane; mostly dull yellow irregularly tinged with red or purple; root dots very distinct; each dot surrounded by a light coloured circle.

Band  $N_3$ —Very distinct; dull blue grey in colour.

*Height*—8 to 9 feet without tops.

*Girth*—4" to 4½"; uniform.

*Internodes*—1½" to 6".

*Aerial Roots*—Few or none.

*Buds*—Small; round; covered by a shining scale covering; light colour on the upper nodes, and dull purple on the lower one.

DR. LEATHER'S *Analysis*—

Pooná Farm Crop.

		1896.	1897.
Percentage of juice to cane	...	60.75	65.47
Do. of sugar to juice	...	12.88	12.50
Do. of glucose in juice	...	1.62	1.10

**Variety—Purple Cane.**

*Where grown*—Bijápur; Bassein, Thána District.

*General Appearance*—A fairly tall and moderately thick cane; lower internodes dull purple, irregularly scored vertically with dull *khaki* colour; upper internodes lighter in colour, with a streaked appearance; slightly resembling streaked cane.

*Type*—E.

*Flower*—None.

*Nodes*—Ring  $N_1$ —Indistinct; of variable colour; upper nodes pale yellow; lower ones dull purple.

Band  $N_2$ —Pale yellow in upper nodes; pale dull and brown and purple in lower ones.

Band  $N_3$ —Very distinct; light blue grey in colour.

*Height*—7 to 8 feet without tops, when well grown.

*Girth*—3½" to 4"; lower internodes considerably smaller in diameter than the middle ones.

*Internodes*—3½" to 5".

*Aerial Roots*—Very few or none.

*Buds*—Narrow; long; pointed; covered with filious scalelike covering; upper buds inclined to shoot early.

PURPLE  
CANE.

**KACHHA-  
RUM:  
Sugar.**
**VARIETIES  
OF CANE  
EXAMINED.**
**Cultivation of Sugarcane in the**

DR. LEATHER'S Analysis—	Poona		Farm		Crop.	
	(Bijapur Purple Cane.)		(Bassein Purple Cane.)			
	1893.		1897.		1896.	1897.
	(Fresh imports.)		(Acclimatized 1 year.)		(Fresh imports.)	(Acclimatized 1 year.)
Percentage of juice to cane ...	63.00		63.40		57.30	61.80
Do. of sugar to juice ...	13.27		13.60		13.31	13.00
Do. of glucose in juice ...	1.33		1.40		1.22	1.74

**KARE  
KABBU.**

*Variety*—**Kare Kabbu** (*Kare*=black, *Kabbu*=sugarcane.)

*Where grown*—Belgaum, Khánápur, Belgaum District; and Raibennur, Dhárwár District.

*General Appearance*—A dark purple cane of fair length, and moderately thick; the general colour is tinged with green towards top, when cane is immature; ratoons fairly well.

*Type*—E, but only slightly zig-zag.

*Bloom*—None.

*Nodes*—Ring N<sub>1</sub>—Distinct; varies in colour similarly to Band N<sub>1</sub>.

Band N<sub>2</sub>—Light purple or yellow green at upper end of cane; purple at lower end; root dots distinct.

Band N<sub>3</sub>—Blue grey.

*Height*—6 to 7½ feet without tops, when well grown.

*Girth*—3½" to 3¾".

*Internodes*—3" to 4".

*Buds*—Dull khaki or light brown in colour; medium in size; oval.

**DR. LEATHER'S Analysis—**

	Poona Farm Crop.			Belgaum, Khánápur and Raibennur Crop. (Local.)
	(Belgaum Cane.)	(Khánápur Cane.)	(Raibennur Cane.)	
	1896.	1896.	1896.	1896.
Percentage of juice to cane ...	60.70	63.00	54.40	60.70 to 66.00
Do. of sugar to juice ...	11.67	6.13	10.27	13.22 to 16.67
Do. of glucose in juice ...	1.54	2.57	1.60	0.82 to 1.77

**RAMRASDAI.**

*Variety*—**Ra'mrasda'i.**

*Where grown*—Haliál, Kánara District.

*General Appearance*—A fairly tall soft cane; uniform in thickness, irregularly streaked with dull purple and pale green streaks, varying very irregularly in width; ratoons fairly well.

**S. 126—40.**

## Bombay Presidency.

(James Morrison)

SACCHA-  
RUM :  
SUGAR.VARIETIES  
OF CANE  
EXAMINED

*Type*.—A and E combined; only slightly zigzag; internodes slightly bulged sometimes.

*Stems*.—A little.

*Nodes*.—Ring  $N_1$ —Fairly distinct; varies in colour.

Band  $N_2$ —Regular in shape; not distinctly marked; root dots fairly distinct.

Band  $N_3$ —Distinct; light blue-gray in colour.

*Height*.—7 to 8 feet without tops.

*Girth*.—3½" to 4"; regular throughout.

*Internodes*.—5" to 7".

*Aerial Roots*.—None or few.

*Bark*.—Fair sized; rounded; pointed; covered by fibrous brown scales.

DR. LEATHER'S *Analysis*.—

PUNJI FARM CO-OP.			
1896.	1897.		
(Gross)	(Actualized)		
(Exports)	(1 year)		
Pounds of juice to cane	...	7010	6970
Do. of sugar to juice	...	822	1150
Do. of glucose to juice	...	241	080

Family.—**Streaked Cane.**

*Local name*.—Gadlag, Dhurwar District; also Belgam and Khadapur, Belgam District.

*Local Appearance*.—A tall, thick, soft cane; irregularly streaked in purple and green or pale purple and yellow colours; streaks not so distinct as in *Ramraditi*.

*Type*.—C and E combined; but internodes only slightly bulged and cane only slightly zigzag in appearance.

*Stems*.—Good deal.

*Nodes*.—Ring  $N_1$ —Fairly well marked; varying in colour; upper nodes yellow; lower nodes irregular in colour.

Band  $N_2$ —Irregular; also varies in colour; root dots very distinct but small.

Band  $N_3$ —Distinct; light blue-gray coloured.

*Height*.—7 to 8 feet without tops.

*Girth*.—4" to 4½"; thick canes 5".

*Internodes*.—4" to 5"; lower internodes slightly smaller in diameter than the middle ones.

*Aerial Roots*.—None.

1291-8

**SAGGHA-  
KUM:  
Sugar.**

**VARIETIES  
OF CANE  
EXAMINED.**

**Cultivation of Sugarcane in the**

*Buds*—Fairly large; pointed; prominent; covered with *khaki* covered scales.

**DR. LEATHER'S Analysis—**

	From Farm Crop (Kiln-dried Cane from Cawnpore) 1906. Fresh (Imports.)	1907. (Acclimatized 1 year.)	Belgaum, Kankrej and Cawnpore Local 1906.
Percentage of juice to cane	70.30	68.56	71
Do. of sugar to juice	8.87	14.30	14.54 to 17.37
Do. of glucose in juice	2.12	0.50	0.79 to 1.20

**(B.)—VARIETIES OUTSIDE THE BOMBAY PRESIDENCY.**

(Examined by DR. LEATHER.)

**MADRASI  
POUNDS.**

**Variety—Madras Pounds.**

*Where grown*—Sitapur; Bara Banki; Bareilly.

*General Appearance*—A thick, orange, yellow to green straight cane; this is a very erect strong cane, harder outside than most *Pounds*; little liable to crack lengthwise or to fall down; it gives about 7 per cent. of juice and has about 15 to 16 per cent. of sugar in the juice (*vide* Cawnpore Farm Experiments).

*Type*—A; frequently C.

*Bloom*—None.

*Nodes*—Ring N<sub>1</sub>—Generally indistinct or absent.

Band N<sub>2</sub>—Drab or green; root dots prominent.

Band N<sub>3</sub>—Distinct; gray coloured.

*Height*—5 to 8 feet.

*Girth*—4" to 4½".

*Internodes*—3½" to 5".

*Aerial Roots*—Common; they grow from one node to the other in the *Shahranpuri Pounds*.

*Dry Leaves*—Generally open out.

**SAMSA'RA.**

**Variety—Samsa'ra.**

*Where grown*—Dumraon; Burdwan.

*General Appearance*—A yellow green cane; frequently lemon-yellow or orange coloured where exposed to sunlight; erect.

*Type*—C; sometimes A.

*Bloom*—Very little; no scorings.

*Nodes*—Ring N<sub>1</sub>—Narrow; indistinct.

Band N<sub>2</sub>—Orange or yellow green; root dots distinct.

Band N<sub>3</sub>—Well defined; gray.

Bombay Presidency.

(J. W. Leather.)

**SACCHARUM:**  
**SUGAR.**

VARIETIES  
OF CANE  
EXAMINED.

*Height*—4 to 6 feet at Damraon; 5' to 12' feet at Burdwan.  
*Girth*—3½" to 4".  
*Internodes*—3½" to 1½".  
*Aerial Roots*—Many; they grow from one node to the next below in a very characteristic manner.  
*Buds*—Large; groove narrow deep.  
*Dry Leaves*—Open out from cane.  
*DR. LEATHER'S Analysis*—

	Damraon Castor cake plot.	Farm Crop, Cattle dung plot.	Burdwan Castor cake plot.	Farm Crop, Cattle dung plot.	Village Kasol, gathi.	Village Banjala.	Village Hartimal.
Percentage of juice	...	...	...	...	71.80	73.30	67.70
Percentage of sugar	12.36	15.36	14.24	16.24	15.24	15.21	15.24
Percentage of glucose in juice	1.34	0.72	1.86	1.98	1.86	1.86	1.86
Specific gravity at 15°C.	1.067	1.074	1.076	1.076	1.079	1.078	1.078

*Variety*—**Shah'sranpuri.**

*Where grown*—Cawnpore and Bareilly.

*General Appearance*—Yellow-green coloured; straight; generally free from black patches at Cawnpore; but some patches found at Bareilly.

*Type*—Generally C; less frequently A.

*Blossom*—A little.

*Notes*—Ring N<sub>1</sub>—Indistinct; green.

Band N<sub>2</sub>—Orange coloured; root dots very distinct.

Band N<sub>3</sub>—Blue gray.

*Buds*—Very liable to shoot.

*Height*—4 to 6 feet.

*Girth*—3½" to 4".

*Internodes*—2" to 3"; sometimes 5".

*Aerial Roots*—Very frequent throughout the whole length of cane and grow from one node to the other.

*Dry Leaves*—Open out and expose the cane.

*DR. LEATHER'S Analysis*—

	Cawnpore Crop.	Bareilly Crop.
Percentage of sugar to juice...	13.64	14.92
Percentage of glucose in juice	0.67	0.37
Specific gravity at 15°C.	1.066	1.070

SHAH'SRAN-  
PURI.



**SACCHA-  
RUM;  
SUGAR.**
**Cultivation of Sugarcane in the**
**VARIETIES  
OF CANE  
EXAMINED.  
K&JH.**

*Variety*—**Ka'JH.**

*Where grown*—Burdwan.

*General Appearance*—A purple cane; straight.

*Type*—A or D.

*Bloom*—Good deal.

*Nodes*—Ring N<sub>1</sub>—Indistinct; yellow or purple.

Band N<sub>2</sub>—Generally yellow on upper part; purple on lower end; root dots prominent.

Band N<sub>3</sub>—Distinct; gray.

*Height*—6 to 8 feet.

*Girth*—3".

*Internodes*—3" to 3½".

*Aerial Roots*—Many; halfway up the cane.

<b>DR. LEATHER'S Analysis—</b>	Village Hartimal.	Village Kantalgachi.	Village Bisnupur.
Percentage of juice to cane ...	65.00	63.10	64.40
Do. of sugar to juice ...	17.05	17.95	17.95
Do. of G <sub>100</sub> to cane ...	13.00	13.00	13.00
Do. of glucose in juice ...	1.54	1.51	1.54
Specific gravity at 15° C. ...	1.063	1.080	1.080

**PURPLE  
POUNDA.**

*Variety*—**Purple Pounda.**

*Where grown*—Bāra Banki; Bareilly.

*General Appearance*—Sometimes reddish purple, sometimes very dark purple.

*Bloom*—Only on the Band N<sub>3</sub> below the nodes.

*Height*—5 to 7 feet.

*Girth*—3½" to 4½".

*Internodes*—3" to 4½".

*Aerial Roots*—Sometimes at lower end.

*Dry Leaves*—Fall off.

**MUNGO.**

*Variety*—**Mungo.**

*Where grown*—Dumraon.

*General Appearance*—Yellow-green coloured; straight; without scored, and with no black patches; very like *Bhurli* but the leaves are of a lighter green colour and are soft and crumple up.

*Type*—B.

*Bloom*—Much.

**S. 126—40.**

## Bombay Presidency.

(J. W. Leather.)

**SACCHA-  
RUM:  
Sugar.**VARIETIES  
OF CANE  
EXAMINED.Nodes—Ring  $N_1$ —Indistinct and drab.Band  $N_2$ —Drab; root dots not very distinct.Band  $N_3$ —Indistinct.

Height—5 to 7 feet.

Girth—2" to 2½".

Internodes—3½" to 4½".

Aerial Roots—None.

Buds—Small.

Dry Leaves—Remain folded.

DR. LEATHER'S Analysis—

		Dumraon Farm Crop 1897	
		Castor cake plot.	Cattle-dung plot.
Percentage of sugar to juice	...	11.73	13.53
Do. of glucose in juice	...	1.18	0.46
Specific gravity at 15° C.	...	1.053	1.061

**Variety Bharii.**

Place grown—Dumraon.

Bharii

General Appearance—A short yellow-green coloured cane; straight and of uniform thickness; black patches infrequent; scoring infrequent; very like *Mungo*; the canes of these two varieties are almost indistinguishable, but the green leaves are quite distinct; those of *Bharii* are deeper green and not soft and crumpled up like *Mungo*.

Type—B.

Buds—Considerable.

Nodes—Ring  $N_1$ —Indistinct; drab.Band  $N_2$ —Drab; green; root dots distinct.Band  $N_3$ —Indistinct; gray.

Height—4 to 6 feet.

Girth—2" to 2½".

Internodes—3½".

Aerial Roots—None.

Dry Leaves—Sometimes open out; sometimes remain folded.

DR. LEATHER'S Analysis—

		Dumraon Farm Crop.	
		Castor cake plot.	Cattle-dung plot.
Percentage of sugar to juice	...	13.76	16.09
Do. of glucose in juice	...	0.70	0.23
Specific gravity at 15° C.	...	1.007	1.071

**SACCHA-  
RUM:  
Sugar.**
**Cultivation of Sugarcane in the**
**VARIETIES  
OF CANE  
EXAMINED.  
PANS'BI.**
**Variety—Pansa'bi.**

*Where grown*—Beha.

*General Appearance*—A cane taller than the *Mwago* and *Blurita* which it is grown; green and yellow-green coloured; erect; black patches frequent.

*Type*—D.

*Bloom*—Not much.

*Nodes* Ring  $N_1$ —Indistinct; narrow; orange.

Band  $N_2$ —Drab coloured; root dots indistinct.

Band  $N_3$ —Gray.

*Height*—4 to 6 feet.

*Girth*—2' to 2½'.

*Internodes*—2" to 4".

*Aerial Roots*—Common at lower end.

*Buds*—Small and round.

*Dry Leaves*—Open out from cane.

**DR. LEATHER'S Analysis—**

Percentage of juice to cane	...	...	...	31.53
Do. of sugar to juice	...	...	...	14.56
Do. of glucose in juice	...	...	...	9.44
Specific gravity at 15.5° C.	...	...	...	1.071

**KHA'BI.**
**Variety—Kha'bi.**

*Where grown*—Dumraon and Burdwan.

*General Appearance*—A tall thin, hard, yellow-green cane; sometimes pinkish coloured, where exposed; at Dumraon, quite straight; at Burdwan, much bent at upper end; frequently many black patches, scorings common.

*Type*—D.

*Bloom*—Much.

*Nodes*.—Ring  $N_1$ —Very distinct; orange coloured.

Band  $N_2$ —Narrow; drab; root dots indistinct.

Band  $N_3$ —Not very distinct.

*Height*—6 to 8 feet.

*Girth*—2½' to 3½'.

*Internodes*—3½" to 5".

*Aerial Roots*—Some.

*Buds*—Large; groove very little developed.

*Dry Leaves*—Open out partly.

Bombay Presidency.

(J. W. Leather.)

**SACCHA  
RUM:  
Sugar.**

DR. LEATHER'S Analysis—	Dumraon Farm Crop.		Burdwan Farm Crop.	
	Castor cake pct.	Co-solub. pct.	Castor cake pct.	Co-solub. pct.
Percentage of juice to cane ...	...	...	...	61.80
Do. of sugar to juice ...	10.93	15.43	16.69	18.96
Do. of glucose in juice...	0.71	0.32	1.03	0.36
Specific gravity at 15.5° C. ...	1.028*	1.073	1.073	1.024

VARIETIES  
OF CANE  
EXAMINED.

**Variety—Puri.**

*Where grown*—Burdwan.

*General Appearance*—A clean yellow or yellow-green cane; straight; no scarrings.

*Top*—B.

*Bloom*—None.

*Nodes*—Ring N<sub>1</sub>—Fairly distinct; narrow; lemon-coloured.

Band N<sub>2</sub>—Cream coloured; root dots distinct.

Band N<sub>3</sub>—Very distinct; gray.

*Height*—4 to 6 feet.

*Girth*—2½".

*Internodes*—2½".

*Aerial Roots*—Some.

*Roots*—Small.

DR. LEATHER'S Analysis—

Percentage of juice to cane ...	...	...	...	72.10
Do. of sugar to juice ...	...	...	...	38.02
Do. of Gluc to cane ...	...	...	...	11.30
Do. of glucose in juice ...	...	...	...	0.76
Specific gravity at 15.5° C. ...	...	...	...	1.083

**Variety—Dikchan.**

*Where grown*—Cawnpore; Shahjahanpur.

*General Appearance*—Yellow-green coloured; some black patches; inclined to grow crooked.

*Top*—D.

*Bloom*—A good deal.

*Nodes*—Ring N<sub>1</sub>—Distinct and very broad; sometimes as broad as the Band N<sub>2</sub>.

Band N<sub>2</sub>—Yellow or green coloured; root dots very prominent.

Band N<sub>3</sub>—Blue-gray.

DIKCHAN.

\* Much laid.

**SACCHA-  
RUM;  
Sugar.****Cultivation of Sugarcane in the****VARIETIES  
OF CANE  
EXAMINED.***Height*—8 to 10 feet.*Girth*—2" to 2½".*Internodes*—4½" to 5".*Aerial Roots*—Very frequent and extend a long way up the cane at lower end at Sháhjahánpur.*Dry Leaves*—Remain folded.**DR. LEATHER'S Analysis—**

Percentage of sugar to juice ...	...	...	...	10.90
Do. of glucose in juice ...	...	...	...	9.19
Specific gravity at 16.5° C. ...	...	...	...	1.029

**DHAUL;  
DHAUR.***Variety*—**Dhaul; Dhaur.***Where grown*—Cawnpore; Bareilly; Sháhjahánpur.*General Appearance*—Mainly drab coloured, but tinged with green at the top and bottom ends; scored longitudinally.*Type*—B.*Bloom*—Good deal.*Nodes*—Ring N<sub>1</sub>—Distinct; orange coloured or brick red; frequently broader at one side than at the other.Band N<sub>2</sub>—Drab or green coloured; root dots distinct and prominent.Band N<sub>3</sub>—Gray coloured.*Height*—6 to 8 feet.*Girth*—2" to 2½".*Internodes*—5" to 6".*Aerial Roots*—Occasionally at lower end.*Dry Leaves*—Remain folded tight.**DR. LEATHER'S Analysis—**

Percentage of sugar to juice ...	...	...	...	12.32
Do. of glucose in juice ...	...	...	...	9.57
Specific gravity at 15.5° C. ...	...	...	...	1.026

**MATNA.***Variety*—**Matna.***Where grown*—Cawnpore and Sháhjahánpur.*General Appearance*—Green and drab coloured; fairly straight, but the tall ones bent at the top; scored longitudinally; black patches infrequent.*Type*—B; sometimes C.*Bloom*—Good deal.

## Bombay Presidency.

(J. W. Leather)

SACCHA-  
RUM:  
Sugar.VARIETIES OF  
CANE  
EXAMINED.*Nodes*—Ring  $N_1$ —Orange coloured and moderately distinct.Band  $N_2$ —Drab; root dots very distinct.Band  $N_3$ —Very indistinct.*Height*—7 to 8 feet.*Girth*—2" to 2½" at Cawnpore; 2" to 3" at Sháhjahánpur.*Internodes*—4" at Cawnpore; 5" to 3" at Sháhjahánpur*Aerial Roots*—None.*dry Leaves*—Remain folded.DR. LEATHER'S *Analysis*—

Percentage of sugar to juice	...	...	...	13.36
Do. of glucose in juice	...	...	...	0.77
Specific gravity at 15.5° C.	...	...	...	1.067

*Variety*—Pansa'bi.*Where grown*—Gorakhpore.*General Appearance*—A pale green to yellow cane; straight; inclined to spout at upper end. This is probably not the same as the Pansa'bi grown at Behea.*Roots*—Some.*Height*—6 feet.*Girth*—2½".*Internodes*—4½" to 5".*Aerial Roots*—None.*dry Leaves*—Remain folded.*Variety*—Chuni.*Where grown*—Bareilly, Sháhjahánpur.*General Appearance*—Mostly yellow, with pale-green; very like *Kilra*; but the internodes are longer and the Band  $N_3$  is much darker.*Type*—B.*Blow*—Good deal.*Nodes*—Band  $N_3$ —Distinct; blue-gray.*Height*—4 to 6 or 7 feet.*Girth*—2" to 2½".*Internodes*—4' to 6".*Aerial Roots*—Common at lower end.

PANSABI

CHUNI

**SACCHA-  
RUM:  
SUGAR.**

**Cultivation of Sugarcane in the**

**VARIETIES OF  
CANE  
EXAMINED.  
NARAUTI.**

*Variety—Narauti.*

*Where grown—Bāra Banki.*

*General Appearance—A white cane; bluish coloured at nodes.*

*Bloom—A little.*

*Height—3 to 4 feet.*

*Girth—1½" to 2½".*

*Internodes—2½" to 3".*

*Aerial Roots—Infrequent.*

**KANWAR.**

*Variety.—KANWAR.*

*Where grown—Bāra Banki.*

*General Appearance—A bluish white coloured cane; upright.*

*Bloom—Some.*

*Height—3 to 5 feet.*

*Girth—1½" to 2½".*

*Internodes—2½" to 3".*

*Aerial Roots—None.*

*Dry Leaves—Remain folded tight.*

**KITAVA.**

*Variety—Kitava.*

*Where grown—Shāhjahānpur and Bāra Banki.*

*General Appearance—A pale yellow to green cane.*

*Bloom—Fair amount, especially at nodes.*

*Nodes—Almost colourless and smooth.*

*Height—4 feet.*

*Girth—2" to 2½".*

*Internodes—3" to 4".*

*Aerial Roots—A little at lower end.*

An experiment made by Mr. RICKETTS, Special Manager of Court Wards' Estates, Bāra Banki, on 728 sq. feet gave the following result. It is equal to an outturn of 2,154 lbs. *Gur* per acre. The land was unirrigated alluvium.

					lbs.
Cane	...	...	...	...	500
Juice	...	...	...	...	310
<i>Gur</i>	...	...	...	...	36
Percentage of juice to cane	...	...	...	...	62.0
Do. of <i>Gur</i> to cane	...	...	...	...	7.2

## Bombay Presidency.

(J. W. Leather.)

SACCHA-  
RUM:  
Sugar.VARIETIES OF  
CANE  
EXAMINED.  
REHRA.*Variety*—Rehra.*Where grown*—Gorakhpore.*General Appearance*—A pale yellow cane; inclined to sprout at the top end.*Bases*—Same.*Sides*—Smooth.*Height*—5 feet.*Girth*—2½".*Internodes*—2" to 3½".*Joint Roots*—None.*Long Leaves*—Open out more or less.

RANWIR.

*Variety*—Ranwir.*Where grown*—Sitapur, Bāra Banki.*General Appearance*—A yellow cane with pink patches; smooth and straight; does not sprout.*Bases*—Much.*Sides*—Smooth, with orange ring above them.*Height*—4 to 6 feet.*Girth*—1½" to 2".*Internodes*—3" to 6".*Joint Roots*—Common at lower end.*Long Leaves*—Remain folded.

The following figures were obtained in experiments made by Messrs. MARTIN and RICKETTS, Special Managers, Court of Wards' Estates, Sitapur and Bāra Banki. Mr. MARTIN's test was taken on  $\frac{1}{32}$  acre and shows an outturn of 1,824 lbs. *Gur* per acre; Mr. RICKETTS' was on 1,019 square feet, and is equal to 2,370 lbs. *Gur* per acre.

	Mr. MARTIN'S test (Sitapur.)	Mr. RICKETTS' test (Bāra Banki.)
Cane	795	560
Juice	420	269
<i>Gur</i>	57	56
Percentage of juice to cane	52.6	57.8
Do. of <i>Gur</i> to cane	7.1	11.2



### Cultivation of Sugarcane in the

**Variety—Parrah.**

*Where grown*—Sitapur.

*General Appearance*—A straw-yellow to pale-green coloured and fairly straight.

*Bloom*—Good deal of pale blue.

*Nodes*—Dark-green above node.

*Buds*—Inclined to sprout.

*Height*—5 to 6 feet.

Girth—2½" to 2¾".

*Internodes*—3" to 4½".

*Aerial Roots*—None.

**Dry Leaves**—Remain folded tight.

A test made by Mr. MARTIN, Special Manager of Court of Ward Estates, gave the following outturn on  $\frac{1}{32}$  acre, which was equal to 2,818 lbs. *Grain* per acre.

Cane	...	...	...	...	...	1,061
Juice	...	...	...	...	...	377
Gur	...	...	...	...	...	89
Percentage of juice to cane	...	...	...	...	...	54.2
D. of Gur to cane	...	...	...	...	...	8.3

**Variety—Ka'rwie.**

*Where grown*—Barn Banki.

*General Appearance*.—A pale-yellow cane; thinner at lower end than at upper end. This cane appears to be similar to *C. hual.*

**Bloom**—A good deal.

**Notes**—Smooth; Ring N<sub>1</sub> distinct and orange-yellow coloured.

*Height*—3 to 5 feet.

Girth—14" to 2'.

*Internodes*—3" to 5".

**Aerial Roots**—Some at lower end.

*Dry Leaves*--Remain folded tight.

**Foristg.—Thun.**

*Where grown—Sháhjahánpur.*

*General Appearance*.—A yellow-green cane; much inclined to spread along its whole length; straight.

8. 128-40.

## Bombay Presidency.

(J. W. Leather.)

SACCHA-  
RUM:  
SUGAR.VARIETIES  
OF CANE  
EXAMINED.*Mean*—None.*Height*—4 to 5 feet.*Girth*—3½" to 4".*Internodes*—2½" to 3½".*Variety*—Munga.*Where grown*—Bára Banki.*General Appearance*—A yellow and bright green coloured cane; straight.*Bloom*—Hardly any.*Height*—6 to 7 feet.*Girth*—1½" to 2".*Internodes*—4" to 6".

MUNGA.

*Variety*—Munga.*Where grown*—Sháhjahánpur.*General Appearance*—A bright green coloured cane; inclined to grow crooked. It is doubtful whether this is the same variety as that called *Munga* at Bára Banki.*Type*—D.*Bloom*—Hardly any.*Height*—5 feet.*Girth*—2" to 2½".*Internodes*—2½" to 4".*Aerial Roots*—Common for ½ of the whole length.

MUNGA.

*Variety*—Ra'kra.*Where grown*—Sháhjahánpur.*General Appearance*—Colour almost white.*Type*—B.*Bloom*—A little.*Nodes*—Ring N<sub>1</sub> distinct; yellow.*Height*—7 feet.*Girth*—2" to 2½".*Internodes*—2½" to 3½".*Aerial Roots*—None.*Dry Leaves*—Remain folded tight.

RAKRA.







All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. GEORGE WATT, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain Series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series; those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

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This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

## NOTICE.

Future issues of this publication placed under either the "Special Veterinary" or "Special Forest Series" will not be included in the annual enumeration. Such papers are printed for Departmental purposes. Their unfortunate inclusion in the system of annual numbering has led recipients of the ordinary issues to think their sets incomplete.

The following pamphlets have already appeared as Special issues, and have not accordingly been furnished to the public:

1894	...	...	...	...	Nos. 8, 9, 10, 11, 12 and 13.
1895	...	...	...	...	No. 8.

